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Operation & Maintenance

domestic water system, towers A & B

WORLD TRADE CENTER

Instruction Manual No. 14

Operation and Maintenance of

DOMESTIC WATER SYSTEM
TOWERS A&B

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F O R E W O R D

The instructions and recommendations in this manual are presented to aid and guide World Trade Center personnel who operate and maintain the Domestic Water System, Towers A and B, in the World Trade Center.

Operating and maintenance personnel must nonetheless comply with all Port Authority approved safety procedures as well as with instructions provided by plant supervisory staff.

The contents of this instruction manual have been researched, compiled, and prepared by the Maintenance Methods Section of the Maintenance Engineering Design Division, Engineering Department, with the cooperation of the World Trade Department.

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CHAPTER 1

INTRODUCTION

SCOPE

The Domestic Water Systems in Towers A and B, World Trade Center, are the subject of this manual. It is divided into 5 chapters.

Chapter 1 is an Introduction. It discusses the scope of the manual.

Chapter 2 describes the Domestic Cold Water System, including the water intake system, the mechanical and electrical controls associated with the pumping stations, and the pressure reducing stations. The fire system makeup and the HVAC makeup are also discussed briefly in Chapter 2.

Chapter 3 describes the Domestic Hot Water System, including the hot water preheaters, the hot water heaters, and the hot water circulating pumps.

Chapter 4 describes the Domestic Water Distribution in the various zones.

Chapter 5 presents the maintenance procedures and schedules for the Domestic Water System.

This manual covers domestic water distribution from Floor 2 thru the roof in each tower. Domestic water distribution on the Concourse Level and the Sublevels will be covered in another manual.

DOMESTIC WATER SYSTEM

The Domestic Water Systems and equipment in Towers A and B are basically similar. A schematic diagram of a Domestic Water System is presented in Figure 1.1. This diagram applies to the Domestic Water Systems in both Towers A and B. The equipment discussed in this manual is in Tower A.

NOTES ON APPENDICES

Appendices A, B, C, D, and E are at the back of this manual.

Appendix A contains all illustrations that support the text in each chapter. The illustrations are numbered and presented in the sequence in which they are first referred to.

Appendix B contains the Domestic Water Pump Control Reference.

Appendix C contains the Abbreviations For Text And Drawings.

Appendix D contains the Mechanical Symbols, with explanations.

Appendix E contains the Electrical Symbols, with explanations.

Appendix F contains the References which were used in the preparation of this manual.

CHAPTER 2

DOMESTIC COLD WATER SYSTEM

SCOPE

This chapter describes the components and controls associated with the Domestic Cold Water System.

DESCRIPTION

A schematic of the Domestic Water System is shown in Figure 1.1. The Domestic Cold Water System is described by locations in the following paragraphs.

Pump Room - Level B1

City water at a pressure of about 50 PSI enters the Pump Room on Level B1. See Figure 1.1 This water passes through a water meter, which measures the amount of water consumed in the tower in which the meter is located. Backflow preventer-1 in the supply line prevents water flow from outlet to inlet when there is a loss of pressure on the inlet side. The function of the low pressure switch (LPS-1) is to shut down all domestic water pumps in the Pump Room (Pumping Station No. 1) and to sound an alarm at the Police Desk on Level B1 if water pressure at the location of the switch falls below 10 PSI. Pumping Station No. 1 pumps water from Level B1 to Floor 41. Pressure of water entering Pumping Station No. 1 is about 50 PSI. Pressure of water discharging from Pumping Station No. 1 is about 250 PSI.

Mechanical Equipment Room (MER) - Floor 7

Some of the water from Pumping Station No. 1 on Level B1 is fed to Pressure Reducing Valve Station No. 1 (PRVS-1) in the MER on Floor 7. See Figure 1.1. The basic function of the pressure

reducing station is to reduce the pressure of water from a high value of approximately 225 PSI to a lower value of about 125 PSI. The water pressure is reduced since water from PRVS-1 is required to be delivered to the 24th floor only. A portion of the water discharging from PRVS-1 is fed to the Cold Water Distribution System which covers up to Floor 24 and a portion is fed to Hot Water Preheater No. 1.

Mechanical Equipment Room (MER) - Floor 41

When the water discharging from Pumping Station No. 1 at 250 PSI reaches the 41st floor, the water pressure is reduced to about 35 PSI. There is a cushion tank, a low pressure switch (LPS-2), a high pressure switch (HPS-1), and main and standby pressure-electric transducers (PET-1) in the main water line. See Figure 1.1

The basic function of Cushion Tank-1 is to absorb surges of pressure which occur in the water system from Level B1 to Floor 41. The cushion tank relieves water pressure surges by channeling water to the floor drain.

The basic function of the high pressure switch (HPS-1) is to shut down Pumping Station No. 1 and sound an alarm at the Police Desk if water pressure rises above 80 PSI. The high pressure switch is set at 80 PSI. The function of low pressure switch (LPS-2) is to shut down Pumping Station No. 2 in the MER on Floor 41 and sound an alarm at the Police Desk if the pressure falls below 10 PSI.

The basic function of the pressure-electric transducer (PET-1) is to produce an electrical output signal, which is proportional to the system pressure at the location of the transducer. Output from the transducer on the 41st floor is fed to the master controller on Level B1, which starts and shuts off pumps to maintain a constant pressure setting of 35 PSI in response to the output from the transducer.

The function of backflow preventer-2 is basically similar to that of backflow preventer-1, described above.

Some of the water entering the MER on Floor 41 is fed to hot water preheater No. 2 and to the Cold Water Distribution System which covers Floors 25 to 41. The remaining water is fed to Pumping Station No. 2.

Pumping Station No. 2 (PST-2) receives water from Pumping Station No. 1. The pressure of water entering PST-2 is 35 PSI and the pressure of water discharging from PST-2 is about 230 PSI. Pumping Station No. 2 pumps water from Floor 41 to Floor 75. Part of the water discharging from PST-2 is fed to pressure reducing valve station No. 2 (PRVS-2). This station reduces the pressure of water from a high value of about 225 PSI on the inlet side to a low value of about 125 PSI on the outlet side. A portion of the water discharging from PRVS-2 is fed to the Cold Water Distribution System which covers Floors 41 to 58. The remaining water from PRVS-2 is fed to hot water preheater No. 3.

Mechanical Equipment Room (MER) - Floor 75

When the water discharging from Pumping Station No. 2 at 230 PSI reaches the 75th floor, the pressure of water is reduced to about 35 PSI. Cushion Tank-2, a low pressure switch (LPS-3), a high pressure switch (HPS-2), and the main and standby pressure-electric transducers (PET-3) are in the main water line.

Cushion Tank-2 absorbs pressure surges which occur in the water system from Floors 41 to 75.

The function of low pressure switch (LPS-3) is to shut down Pumping Station No. 3 in the MER on Floor 75 and to sound an alarm at the Police Desk if the pressure falls below 10 PSI.

The function of high pressure switch (HPS-2) is to shut down Pumping Station No. 2 in the MER on Floor 41 and sound an alarm at the Police Desk if the pressure rises above 80 PSI.

Pressure-electric transducer (PET-2) produces an output electrical signal which is proportional to the pressure of water

entering the MER on the 75th floor. Output from the transducer (PET-2) is fed to the master controller on Floor 41, which starts or shuts off a pump or two to maintain a constant pressure setting of 35 PSI in response to the output from PET-2.

The function of backflow preventer-3 is basically similar to that of backflow preventer-1.

Part of the water entering the MER on the 75th floor is fed to hot water preheater No. 4 and to the Cold Water Distribution System which covers Floors 59 to 75. The remaining water is fed to Pumping Station No. 3.

Pumping Station No. 3 (PST-3) receives water from Pumping Station No. 2. Pressure of water entering PST-3 is about 25 PSI and pressure of water discharging from PST-3 is about 200 PSI. PST-3 pumps water from Floors 75 to 108.

Part of the water discharging from PST-3 is fed to pressure reducing valve station No. 3 (PRVS-3) and the remaining water is pumped up to the MER on Floor 108. PRVS-3 reduces water pressure from a high value of about 200 PSI on the inlet side to a low value of about 125 PSI on the outlet side. A portion of water discharging from PRVS-3 is fed to the Cold Water Distribution System which covers Floors 75 to 92. The remaining water from PRVS-3 is fed to hot water preheater No. 5.

Mechanical Equipment Room - Floor 108

When the water discharging from Pumping Station No. 3 at 200 PSI reaches the MER on the 108th floor, the pressure of water is reduced to about 45 PSI. Cushion Tank-3 (CT-108-1, Zone-3), a high pressure switch (HPS-3), and a main and standby pressure-electric transducer (PET-3) are in the main water line. Cushion Tank-3 absorbs pressure surges which occur in the water system from Floors 75 to 108.

The function of high pressure switch (HPS-3) is to shut down Pumping Station No. 2 in the MER on Floor 41 and sound an alarm at the Police Desk on Level B1 if the pressure rises above 80 PSI.

The pressure-electric transducer (PET-3) produces an output electrical signal which is proportional to the pressure of water entering the MER on the 108th floor. Output from the transducer (PET-3) is fed to the master controller on Floor 75, which starts or shuts off a pump or 2 to maintain a constant pressure setting of 35 PSI in response to the output from PET-3.

Some of the water entering the MER on Floor 108 is fed to the Cold Water Distribution System which covers Floors 93 to 108 and Floor 108 to the roof. The remaining water is fed to hot water preheater No. 7.

WATER INTAKE SYSTEM

General

A schematic diagram of the water intake system is in Figure 2.1. Components of the water intake system are shown in Figure 2.2. Domestic water for Towers A and B is supplied from the New York City Water Supply System. City water enters the Pump Room on Level B1 as shown in Figure 2.2 and is supplied at about 50 PSI. Components of the water intake system are described below.

Water Meter

The basic function of the water meter is to measure the amount of water consumed in the tower in which the meter is located. A view of the water meter is in Figure 2.3. The meter is type TRIDENT, Serial No. 19983511, and it is made by Neptune Meter Co. of New York.

To maintain or replace the water meter, close gate valves CW-1 and CW-2, which are normally open, and open gate valve CW-3, which is normally closed, in the bypass line. See Figures 2.1 and 2.2.

Low Pressure Switch

The basic function of the low pressure switch (LPS-1) is to shut down the Domestic Water System and to sound an alarm at the

Police Desk if water pressure at the switch location falls below 10 PSI. See Figures 2.2 and 2.4. The low pressure switch is set at 10 PSI. The switch is the Pressuretrol type and it is made by Honeywell.

Backflow Preventer

Description. The basic function of a backflow preventer is to prevent waterflow from outlet to inlet (backflow) when there is a loss of pressure on the inlet side. The backflow preventer unit consists of 2 check valves and a differential pressure relief valve. See Figures 2.1 and 2.5. A schematic diagram of the backflow preventer is shown in Figure 2.6. The check valves and the pressure differential relief valve are Clayton Valves made by the Cla-Val Co. of Newport Beach, California. The pressure differential relief valve has the following nameplate data:

Size .... 1/2"
Catalog.. CDB
Stock No. 37672
Range ... 0-7 PSI

Normal Operation. See Figure 2.6. When inlet pressure is higher than outlet pressure, check valves 1a and 1b open. This permits waterflow through the main line and pressurizes sensing lines A and B. Differential Control Unit (6) responds to pressure sensed through lines A and B. When inlet pressure is higher than outlet pressure, differential control unit (6) closes. This directs pressure through restriction (4) into the cover of differential pressure relief valve (3), which causes valve (3) to close.

Backflow Prevention. See Figure 2.6. When outlet pressure is higher than inlet pressure, flow is directed through control lines C into the cover chamber of check valve 1b, which causes valve 1b to close. The higher outlet pressure flows through control line D into the cover chamber of check valve 1a, and check valve 1a closes. With pressure in sensing line B greater than pressure

in sensing line A, differential control unit (6) opens. This relieves pressure in the cover chamber of differential pressure relief valve (3), causing relief valve (3) to open and discharge into the floor drain. Now the outlet pressure is reduced and is lower than the inlet pressure. So the flow is not directed through control lines C into the cover chamber of check valve 1b. So check valve 1b opens. Since the outlet pressure is lower, there is no flow through control lines D into the cover chamber of check valve 1a, and check valve 1a opens.

Switch Assembly Feature. See Figure 2.6. The switch assembly (5) is actuated by a stem extension attached to the stem of differential pressure relief valve (3). The switch assembly is adjusted to actuate (close) a single-pole, double-throw switch when differential pressure relief valve (3) is almost closed.

When the differential pressure relief valve starts to open, the spring-loaded switch actuating lever is released and returns the switch to its normally open position.

Alarm. See Figure 2.6. When the microswitch in the switch assembly is actuated (closed) as described above, there is provision for the switch to sound an alarm at the computer on Level B4 overlooking the Central Refrigeration Plant. (The computer is not in operation at the time of publication of this manual.)

PUMPING STATIONS

General

There are 3 Pumping Stations in each tower. Pumping Station No. 1 is in the Pump Room on Level B1 (Elevation 294'). Pumping Station No. 2 is in the Mechanical Equipment Room on Floor 41. Pumping Station No. 3 is in the Mechanical Equipment Room on Floor 75. See Figure 1.1.

Pumping Station No. 2 on Floor 41 is described here. Pumping Station No. 2 contains 4 pumps, a backflow preventer, an air cushion tank, a high pressure switch, a low pressure switch, main and standby pressure-electric transducers, 4 individual pump

controllers, a master controller, and a pressure reducing valve station. Pumping Stations Nos. 1 and 3 are basically similar to Pumping Station No. 2.

Pumps

General. There are 4 pumps in each pumping station. A schematic of the pumping arrangement in Pumping Station No. 2 in the Mechanical Equipment Room (MER) on the 41st floor is shown in Figure 2.7. This is a typical pumping arrangement. A view of the pumping arrangement is shown in Figure 2.8. Two views of an individual pumping arrangement are shown in Figures 2.9A and 2.9B.

Pressure Gages. For each pump, there is a pressure gage on the suction side (inlet) and on the discharge side (outlet). See Figures 2.9A and 2.9B. The pressure gage on the suction side indicates the pressure of water entering the pump. The pressure gage on the discharge side indicates the pressure of water exiting the pump. On a typical day, the pressure of water entering the pump is 35 PSI and the pressure of water exiting the pump is 235 PSI.

Shutoff Valves. For each pump, there is a shutoff valve on the suction side (inlet) and on the discharge side (outlet). See Figures 2.9A and 2.9B. The shutoff valves are normally open. Maintenance on a pump can be performed by closing the shutoff valves on both sides.

Check Valve. For each pump, there is a check valve on its discharge side. See Figures 2.9A and 2.9B. The basic function of this valve is to prevent flow of water back into the pump (backflow) if there is loss of pressure on the inlet side of the pump. The nameplate data of a typical check valve are as follows:

Size	4
Model	103-BP
Body	BRZ
Trim	BRZ
Press	500 WDG
Temp	

Mueller Steam Specialty Co., Inc., Brooklyn, New York.

Nameplate Data. Nameplate data for pumps in Pumping Stations Nos. 1, 2, and 3 in Tower A are presented in Figures 2.10A, 2.10B, and 2.10C. Nameplate data for pumps in Pumping Stations Nos. 1, 2, and 3 in Tower B are presented in Figures 2.10D, 2.10E, and 2.10F.

Mechanical Controls

Mechanical controls on the 41st floor are shown schematically in Figure 2.11. These mechanical controls are shown in Figures 2.11 thru 2.16. The controls are described below.

Air Cushion Tanks

General. There are 3 air cushion tanks in each tower. There is a cushion tank in each Mechanical Equipment Room on: Floor 41, Floor 75, and Floor 108. See Figure 1.1. The basic function of a cushion tank is to absorb water pressure surges. Views of a cushion tank and its associated controls on Floor 41 are shown in Figures 2.13, 2.14 and 2.15. The cushion tanks and their associated controls on Floors 75 and 108 are basically similar to those on Floor 41.

Operation. When the water in the air cushion tank rises due to a pressure surge, the electrodes short and the liquid level relay energizes. See Figure 2.11. Now solenoid operated valves A and B energize. Solenoid valve A opens and compressed air is admitted into the tank. This air pushes the water down and the water drains out through valve B, thus relieving a pressure surge. When the water level drops below a predetermined level, solenoid valves A and B close.

Pressure Switches

Low Pressure Switch. There is a low pressure switch associated with each pumping station. Low pressure switch LPS-1 is associated with Pumping Station No. 1. Low pressure switch

LPS-2 is associated with Pumping Station No. 2. Low pressure switch LPS-3 is associated with Pumping Station No. 3. See Figure 1.1. The basic function of a low pressure switch is to shut down its associated pumping station and sound an alarm at the Police Desk on Level B1 if water pressure falls below 10 PSI. The low pressure switch on the 41st floor is shown in Figures 2.11 and 2.16. The role of a low pressure switch in the pump shutdown is discussed under electrical controls. The low pressure switches are the Pressuretrol type and they are made by Honeywell. Each low pressure switch is set at 10 PSI with a differential of 1.5 PSI. This means that the appropriate pumping station shuts down when the pressure falls to 10 PSI and the pumping station starts when the pressure rises to 11.5 PSI.

High Pressure Switch. There is a high pressure switch located above each pumping station. See Figure 1.1. The high pressure switch associated with Pumping Station No. 1 is in the MER on the 41st floor. The high pressure switch associated with Pumping Station No. 2 is in the MER on the 75th floor. The high pressure switch associated with Pumping Station No. 3 is in the MER on the 108th floor. The basic function of a high pressure switch is to shut down the pumping station associated with the switch and sound an alarm at the Police Desk if the pressure is above 80 PSI at the switch. The high pressure switch on the 41st floor of the MER is shown in Figures 2.11 and 2.16. This switch is associated with the Pumping Station No. 1 on Level B1. The role of a high pressure switch in pump shutdown is discussed under electrical controls. The high pressure switches are the Pressuretrol type and they are made by Honeywell. Each high pressure switch is set at 80 PSI with a differential of 10 PSI. This means that the appropriate pumping station shuts down when the pressure reaches 80 PSI and the pumps start automatically when the pressure rises to 70 PSI.

Pressure-Electric Transducers

There is a main and a standby pressure-electric transducer associated with each pumping station. The transducers are located well above the pumping station. The transducers (PET-1) associated with Pumping Station No. 1 (Level B1) are located in the MER on the 41st floor. The transducers (PET-2) associated with Pumping Station No. 2 (MER, Floor 41) are located in the MER on the 75th floor. The transducers (PET-3) associated with Pumping Station No. 3 are located in the MER on the 108th floor. See Figure 1.1. The basic function of a pressure-electric transducer is to produce an electrical signal output which is proportional to the system pressure at the location of the transducer. The output of the transducer controls the number of pumps in operation in its associated pumping station.

The main and standby pressure-electric transducers in the MER on Floor 41 are shown in Figures 2.11 and 2.16. These transducers control the pumps in Pumping Station No. 1 on Level B1. The role of a transducer in the control of pumps is discussed fully under electrical controls.

Backflow Preventers

There are 3 backflow preventers in the Domestic Water System. Each backflow preventer is associated with a pumping station. See Figure 1.1. The backflow preventer associated with Pumping Station No. 2 is shown in Figures 2.11 and 2.12, and it is basically similar to the backflow preventer described earlier.

Electrical Controls

General. The electrical controls in a pumping station consist of a master controller and a controller for each pump. A diagram of the individual pump controllers and master controllers in all 3 pumping stations is shown in Figure 2.17A. This diagram also shows the connections of low pressure switches, high pressure switches, and pressure-electric transducers to the master

controllers. The master controller and the individual pump controllers in Pumping Station No. 2, in the MER on Floor 41, are shown in Figure 2.17B. The master controllers and the individual pump controllers in Pumping Stations Nos. 1 and 3 are basically similar to those in Pumping Station No. 2.

The electrical controls relating to Pumping Station No. 2 are described here. The electrical controls relating to Pumping Stations Nos. 1 and 3 are basically similar to the controls in Pumping Station No. 2. The individual pump controllers in a pumping station are connected to the master controller. Each pump is controlled by its individual pump controller and the master controller.

Motor Power Supply. The pump motors require 480V, 3Ø, 60 HZ for their operation. The following table presents data regarding power supply for pump motors in the 3 pumping stations in Tower A:

Pumping Station	*Pump Motors*	*POWER SUPPLY*		
		Circuit No.	*Cubicle No.*	*Substation No.*
No.1	1,2	F-SPAL-6	NP9	T.A. S.S. 294
	3,4	F-SPAR-4	NP7	T.A. S.S. 294
No.2	1,2	F-SS41R-3	R3	South S.S.
	3,4	F-SN41R-3	R3	North S.S.
No.3	1,2	F-SN75R-3	R3	North S.S.
	3,4	F-SS75R-3	R3	South S.S.

The following table presents data regarding power supply for pump motors in the 3 pumping stations in Tower B:

Pumping Station	*Pump Motors*	*POWER SUPPLY*		
		Circuit No.	*Cubicle No.*	*Substation No.*
No.1	1,2	F-SPBL-6	L6	T.B. S.S. 294
	3,4	F-SPBR-4	R4	T.B. S.S. 294
No.2	1,2	F-SE41R-3	R3	East S.S.
	3,4	F-SW41R-3	R3	West S.S.
No.3	1,2	F-SW75R-3	R3	Southwest S.S.
	3,4	F-SE75R-3	R3	Southeast S.S.

Master Controller. The basic function of the master controller is to control the pumps in a pump station. There is one master controller in each pump station. See Figure 2.17A. The master

controller in Pumping Station No. 2 is shown in Figure 2.17B. The front and rear views of the control panel associated with the master controller are shown in Figures 2.18 and 2.19, respectively. An interior view of the master controller is shown in Figure 2.20. A schematic of the master controller is in Figures 2.21a and b, and a related legend is in Figures 2.22A, B, and C. To obtain the description of the components of the master controller, see Appendix B.

Individual Pump Controller. The basic function of an individual pump controller is to control its associated pump with the aid of the master controller. There is an individual pump controller associated with each pump. See Figure 2.17A. The individual pump controllers associated with the 4 pumps in Pumping Station No. 2 are shown in Figure 2.17B. The front and rear views of the control panel associated with an individual pump controller are shown in Figures 2.23 and 2.24, respectively. Two interior views of a typical individual pump controller are shown in Figures 2.25 and 2.26. A schematic of an individual pump controller is shown in Figure 2.27, and a related legend is presented in Figures 2.28A and 2.28B. To obtain a description of the components of an individual pump controller, see Appendix B.

Control System Operation

Automatic Operation. During normal conditions, Pump No. 1 runs in all 3 pumping stations. As the load increases, Pump No. 1 goes to full speed. On a further increase of load, the lead pump will start. Assume Pump No. 2 (P-2) to be the lead pump. As load increases, P-2 runs at full speed. On a further increase of load, Pump No. 3 (P-3) will start. As load increases further, P-3 will come to full speed. On a further increase of load, Pump No. 4 starts and runs at variable speed. The various modes and conditions of operation are discussed below:

1. Alternate Mode. The Pump Run Mode Select Switch (5SS) has 2 positions: OFF and ON. See Figures 2.18 and 2.21a and b.

The switch is normally in the OFF position. In this position, Pump No. 1 runs at variable speed. It will run at full speed as load increases and calls for the lead pump to run at variable speed. In the ON position, Pump No. 1 will shut down if 2 other pumps are running. For example, assume that P-1 is running at full speed. Assume that P-2 is the lead pump. Now P-2 runs at variable speed. As load increases, P-2 runs at full speed and P-3 runs at variable speed. Now pump P-1 shuts off.

2. Lead Interchange. The Lead Pump Mode Select Switch (3SS) has 2 positions: MANUAL and AUTO. See Figures 2.18 and 2.21a and 2.21b. It is normally in the AUTO position. In this position, the lead pump select clock (CL), will automatically select the lead pump. The clock completes one revolution every 24 hours. At the end of each revolution, the clock selects a different lead pump. In the MANUAL position, one of the three pumps (P-2, P-3, or P-4) is selected as the lead pump by rotating the lead pump select clock (CL). Each revolution of the clock changes the selection of the lead pump. In the MANUAL position, the pump that is selected as the lead pump remains as the lead pump.
3. High Pressure Condition. When water pressure at the high pressure switch reaches 80 PSI, the high pressure switch closes. See Figures 2.17A and 2.21a and 2.21b. High pressure lamp 6LT lights. See Figure 2.18. Pump failure relay PF and shunt trip solenoid ST energize. The motor circuit breaker trips and the motor shuts off. See Figure 2.27. The pumps associated with the high pressure switch shut down during the high pressure condition.
4. Low Pressure Condition. When water pressure at the low pressure switch falls to 10 PSI, the low pressure switch closes. See Figures 2.17A and 2.21a and 2.21b. Low

pressure lamp (7LT) lights. See Figure 2.18. Pump failure relay PF and shunt trip solenoid ST energize.

The motor circuit breaker trips and the motor shuts off. See Figure 2.27. The pumps associated with the low pressure switch shut down during the low pressure condition.

5. Thermal Overload Condition. When a thermal overload condition occurs in a motor, the motor thermal switch activates and motor thermal overload relay (MTO) energizes. See Figures 2.27 and 2.29. Shunt trip coil (ST) energizes, the motor circuit breaker trips, and the motor shuts off. When a thermal overload condition occurs in a pump controller, the heatsink thermal switch activates and the controller thermal overload relay (CTO) energizes. See Figures 2.25, 2.26, and 2.27. Shunt trip coil (ST) energizes, the motor circuit breaker trips, and the motor shuts off. An alarm sounds at the Police Desk when a thermal overload condition occurs in a motor or in a controller.

Manual Operation. When the Domestic Water System is shut down it has to be started manually, and after the pressures are equalized the system is put in the automatic mode. The following steps are taken to start the system manually:

1. Place all Pump Run Mode Select Switches (1SS) in the MANUAL position. See Figures 2.23 and 2.27.
2. Push the Alarm Reset Switch (1PB) on the master controller. See Figures 2.18 and 2.21.
3. Push the controller reset switch on the individual pump controller. See Figures 2.23 and 2.27.
4. Place all the manual pressure adjust potentiometers (1P) to zero (0) position. See Figures 2.23 and 2.27.
5. Reset the circuit breaker (CB1) in the individual pump controllers. See Figures 2.25, 2.26 and 2.27.
6. Establish communication among the 3 pumping stations.

7. In Pumping Station No. 1, start Pump No. 1 by turning the pressure adjust potentiometer (1P) to the maximum position. See Figures 2.23 and 2.27.
8. In Pumping Station No.1, start Pump No.2 by turning the potentiometer (1P) to the maximum position. See Figures 2.23 and 2.27.
9. Observe the water pressure gage on the master controller in Pumping Station No.1. See Figures 2.18, 2.21a, and 221b. When the pressure gage reads 35 PSI, start Pump No. 1 in Pumping Station No. 2 (Floor 41).
10. If the pressure gage in Pumping Station No. 1 reads below 30 PSI, start Pump No. 3, and vary its speed until the pressure is 35 PSI.
11. Start Pump No. 2 in Pumping Station No. 2 if the pressure gage reading is maintained at 35 PSI in Pumping Station No. 1.
12. Observe the water pressure gage on the master controller in Pumping Station No. 2. See Figure 2.18. When the pressure gage reads 35 PSI, start Pump No. 1 in Pumping Station No. 3 on Floor 75.
13. If the pressure gage in Pumping Station No. 2 reads below 30 PSI, start Pump No. 3 and vary its speed until the pressure is 35 PSI.
14. When the water pressure gages on the master controllers in all 3 pumping stations read a constant presure of 35 PSI, place all Pump Run Mode Select Switches (1SS) in the AUTO position.

PRESSURE REDUCING STATIONS

General

The basic function of a pressure reducing station is to reduce the pressure of pump discharge from about 225 PSI to about 125 PSI. There are 3 pressure reducing stations in each tower. See Figure

1.1. Pressure Reducing Station-1 is in the MER on Floor 7 and is associated with Pumping Station No. 1 on Level B1. Pressure Reducing Station-2 is in the MER on Floor 41 and is associated with Pumping Station No. 2 in the MER on Floor 41. Pressure Reducing Station-3 is in the MER on Floor 75 and is associated with Pumping Station No.3 on Floor 75. All 3 pressure reducing stations are basically similar.

Description

Pressure Reducing Station No.2 in the MER on Floor 41 is described here. A schematic of the pressure reducing station is presented in Figure 2.30. An overall view of the station is shown in Figure 2.31. Partial views of the station are shown in Figures 2.32 thru 2.36. When demand for water is low, water flows only through the bypass line. When demand for water is high, water flows through the bypass and the main lines.

Main line-1 and bypass line-1 supply water for the Cold Water Distribution System. Main line-2 and bypass line-2 supply cold water for the Hot Water Distribution System. The alarms and valves associated with main line-1 and bypass line-1 are basically similar to the alarms and valves associated with main line-2 and bypass line-2. The alarms and valves associated with main line-1 and bypass line-1 are described here.

In the main line, pressure reducing valve D1-1 reduces high pressure (213 PSI) to medium pressure (169 PSI). Pressure reducing valve D2-1 reduces medium pressure (169 PSI) to low pressure (129 PSI). In the bypass line, pressure reducing valve D3-1 reduces high pressure (213 PSI) to medium pressure (174 PSI), and D4-1 reduces medium pressure (174 PSI) to low pressure (134 PSI).

Excess pressure control valve E-1 is normally open. The valve is closed if water pressure at the valve location is in excess of 150 PSI. Pressure relief valve F-1 is normally closed. If water pressure at the location of the switch is more than a predetermined level, valve F-1 opens, draining out water and relieving

pressure. Valve F-1 automatically closes when the pressure is relieved.

Pressure Switches

Low Pressure Switch. Low pressure switch LPS-1 is set for 100 PSI. If water pressure falls below 100 PSI, there is a provision for the switch to sound an alarm at the computer on Level B4 (Elevation 264') in the Central Refrigeration Plant area. (The computer is not in operation at the time of publication of this manual.) Low pressure switch LPS-2 is set for 100 PSI and it is basically similar to switch LPS-1 in its operation.

High Pressure Switch. High pressure switch HPS-1 is set for 200 PSI. If water pressure at the switch location rises above 200 PSI, there is provision for the switch to sound an alarm at the computer in the Central Refrigeration Plant area. (The computer is not in operation at the time of publication of this manual.) The switch is made by Honeywell and is a Pressuretrol type. High pressure switches HPS-2, HPS-3, and HPS-4 are also set for 200 PSI, and they are basically similar.

Excess Pressure Switch. Excess pressure switch EPS-1 is set for 150 PSI. If water pressure at the location of the switch rises above 150 PSI, there is a provision for the switch to sound an alarm at the computer in the Central Refrigeration Plant area. (The computer is not in operation at the time of publication of this manual.) Excess pressure switch EPS-2 is also set for 150 PSI, and it is basically similar to switch EPS-1 in its operation.

Pressure Control Valves

The pressure control valves in the pressure reducing station are described below. These include pressure reducing valves, excess pressure control valves, and pressure relief valves.

Pressure Reducing Valve

General. A schematic of a pressure reducing valve is presented

in Figure 2.37. A typical pressure reducing valve is shown in Figure 2.38.

Operation. Pressure reducing control (3) is a normally open control that senses main valve outlet pressure changes. An increase in outlet pressure tends to close control (3) and a decrease in outlet pressure tends to open control (3). This causes main valve cover pressure to vary and the main valve modulates (opens and closes), thus maintaining a relatively constant outlet pressure.

Adjustment. Turn the adjusting screw on control unit (3) clockwise to increase the setting.

Self-cleaning Strainer. A self-cleaning strainer is installed in the main valve's inlet body, which protects the pilot system from foreign particles.

Excess Pressure Control Valve

General. A schematic of the excess pressure control valve is presented in Figure 2.39. A typical excess pressure control valve is shown in Figure 2.40.

Excess Pressure Shutoff. When inlet water pressure reaches the set point (150 PSI) of pressure reducing control (6), control (6) closes. This closes auxiliary valve (7), directs inlet pressure through restriction fitting (3) into the main valve cover, and closes the main valve. When the inlet water pressure closes control (6) and main valve inlet pressure lowers below the set point (150 PSI) of control (6), check valve (4) closes. This traps the higher pressure in the sensing chamber of control (6) and main valve (1) remains closed, regardless of the lowering inlet pressure.

Manual Reopening. To reopen the main valve after an excess pressure shutoff, press down pushbutton valve (5) to permit pressure to equalize between control (6) sensing chamber and the main valve inlet. If inlet pressure is lower than the set point (150 PSI) of control (6), control (6) reopens, which opens auxiliary valve (7) and the main valve.

Control (6) Adjustment. Turn the adjusting screw clockwise to increase the setting.

Pressure Relief Control Valve

General. A schematic of the pressure relief control valve is presented in Figure 2.41. A typical pressure relief control valve is presented in Figure 2.42.

Pressure Relief Feature. Pressure relief control unit (3) is normally closed and responds to inlet pressure changes. An increase in inlet pressure tends to open control unit (3) and a decrease in inlet pressure tends to close control (3). This causes main valve cover pressure to vary and the main valve (1) modulates (opens and closes), maintaining a relatively constant inlet pressure. When the inlet pressure is lower than the set point of control (3), control (3) closes. This pressurizes the cover of the main valve, whereby the main valve closes.

Closing Speed Control. Needle valve (2) controls the closing speed of the main valve. Turn the adjusting stem clockwise to make the main valve close more slowly. Do not close the needle valve (2) completely or the main valve will not close.

Pressure Relief Control Adjustment. Turn the adjusting screw on control unit (3) clockwise to increase the setting.

FIRE SYSTEM - MAKEUP

Makeup water for the Fire System is supplied from the Domestic Cold Water System, as shown in Figure 1.1.

HVAC - MAKEUP

Makeup water for the Heating, Ventilating, and Air Conditioning System is supplied from the Domestic Cold Water System, as shown in Figure 1.1.

CHAPTER 3

DOMESTIC HOT WATER SYSTEM

SCOPE

This chapter describes the Domestic Hot Water System, including the hot water preheaters and hot water heaters.

DESCRIPTION

The Domestic Hot Water System consists of hot water preheaters, hot water heaters, and hot water circulating pumps. This equipment is in the Mechanical Equipment Rooms on Floors 7, 41, 75 and 108. See Figure 1.1.

Domestic cold water at a temperature of about 60°F is fed to a preheater, in which water is heated by means of condensate. If water is heated to more than 140°F in the preheater, it is mixed with cold water so that it remains at about 105°F. The water from a preheater is fed to its associated heaters. If the water fed to the heaters is at a temperature less than 105°F, the water is heated by means of low pressure steam to about 105°F. If the water fed to the heaters is at a temperature higher than 105°F, the water simply passes through the heaters to the distribution system without further heating. The water from the hot water heaters is supplied to various floors by means of the Hot Water Distribution System. The hot water circulating pumps keep the water circulating and hot until it is delivered. It is to be noted that there is no preheater in the MER on Floor 108 and that the cold water, without being preheated, is fed directly to the hot water heaters. See Figure 1.1. The domestic hot water equipment in each of the MERs is described as follows:

Mechanical Equipment Room - Floor 7

The domestic cold water from pressure reducing valve station No. 1 is fed to hot water preheater No. 1. Preheated water from preheater No. 1 is supplied to hot water heaters No. 2. The hot water from heaters No. 2 is distributed from Floors 9 to 24. Hot water circulating pumps No. 2 keep the water circulating up to Floor 24.

Mechanical Equipment Room - Floor 41

A portion of the domestic cold water from Pumping Station No. 1 discharging on Floor 41 is fed to preheater No. 2. The preheated water from preheater No. 2 is fed to hot water heaters No. 3. The hot water from heaters No. 3 is supplied to the Hot Water Distribution System, which covers Floors 25 to 41. Hot water circulating pumps No. 3 keep the hot water circulating from Floors 41 to 25. A portion of the cold water from pressure reducing valve station No. 2 is fed to preheater No. 3. The preheated water from preheater No. 3 is fed to hot water heaters No. 4. The hot water from heaters No. 4 is supplied to the Hot Water Distribution System, which covers Floors 41 thru 58. Hot water circulating pumps No. 4 keep the hot water circulating from Floors 41 to 58.

Mechanical Equipment Room - Floor 75

Some of the domestic cold water from Pumping Station No. 2 discharging on Floor 75 is fed to hot water preheater No. 5. The preheated water from preheater No. 5 is fed to hot water heaters No. 5. The hot water from heaters No. 5 is fed into the Hot Water Distribution System, which covers Floors 59 to 75. Hot water circulating pumps No. 5 keep the hot water circulating from Floors 59 to 75.

Some of the domestic cold water from pressure reducing valve station No. 3 is fed to preheater No. 5. The preheated water from preheater No. 5 is fed to hot water heaters No. 6. The hot water

from heaters No. 6 is supplied to the Hot Water Distribution System, which covers Floors 75 thru 92. Hot water circulating pumps No. 6 keep the hot water circulating from Floors 75 to 92.

Mechanical Equipment Room - Floor 108

Some of the domestic cold water from Pumping Station No. 3 discharging on Floor 108 is fed to hot water heaters No. 7. Hot water from heaters No. 7 is supplied to the Hot Water Distribution System, which covers from Floor 93 to the roof. Hot water circulating pumps No. 7 circulate hot water from Floor 93 to the roof.

HOT WATER PREHEATERS

General

The basic function of a hot water preheater is to heat cold water by means of condensate. There are 5 preheaters in the Domestic Hot Water System in each tower. See Figure 1.1. All the preheaters are basically similar. Each preheater supplies preheated water to 2 hot water heaters. The hot water preheater (PH-41-3, Downfeed) in the Mechanical Equipment Room on Floor 41 is described here.

Description

The hot water preheater is made by the Patterson-Kelly Co. of East Stroudsburg, Pa. It is a packaged water heater, model PK Control-Flo, Series 500. A schematic of the hot water preheater system is presented in Figure 3.1. The views of the preheater are shown in Figures 3.2 and 3.3. The condensate supply header is shown in Figure 3.4. Various controls are shown in Figures 3.5 and 3.6.

Safety Valves

There are 2 safety valves: one is a water pressure relief valve and the other is an air pressure relief valve.

1. Water Pressure Relief Valve. See Figure 3.2. The basic

function of the water pressure relief valve is to provide protection against excessive water pressure caused by thermal expansion of water. The valve is set at 150 PSI. If water pressure exceeds 150 PSI, the valve opens and drains water until the pressure is relieved. When the water pressure drops to 150 PSI or below, the valve is automatically closed. It is a WATTS relief valve, type 174A.

2. Air Pressure Relief Valve. See Figure 3.2. The basic function of the air pressure relief valve is to provide protection against excessive air pressure. The valve is set at a predetermined pressure. If the air pressure exceeds the set point, the valve opens and vents air until the air pressure is relieved. When the air pressure is relieved, the valve automatically closes. The valve is a Hoffman No. 78 air vent valve.

Temperature Controller

General. The basic function of the temperature controller is to monitor the temperature of the preheated water. The controller is shown in Figure 3.5 and it is set at 105°F. The controller is pneumatic, is made by Honeywell, and is type RP908A 10054.

Operation. The domestic cold water is supplied to the preheater at a temperature of about 60°F. The cold water is heated by the condensate. The heated water from the preheater passes through the 3-way mixing valve without being mixed with cold water if the temperature of the preheated water is less than 105°F. The water from the preheater is mixed with cold water in the 3-way mixing valve if the temperature of the preheated water is more than 105°F.

The position of the 3-way mixing valve is controlled by the temperature controller. The temperature of the preheated water is converted by means of the transducer to an equivalent air pressure which is transmitted to the temperature controller as a

control input. The controller is set at 105°F, which means the desired temperature for the preheated water is 105°F. If the temperature of the preheated water is more than 105°F, the air pressure from the transducer is increased and the controller positions the 3-way mixing valve so that cold water is mixed with water from the preheater. This keeps the temperature of the preheated water below 105°F. If the temperature of the preheated water is less than 105°F, the air pressure is reduced and the controller positions the 3-way mixing valve so that water from the preheater passes through it without being mixed with cold water.

HOT WATER HEATERS

There are 12 steam hot water heaters in each tower, 4 electric hot water heaters in Tower A, and 5 electric hot water heaters in Tower B. See Figure 1.1. The steam hot water heaters are in the MERs on Floors 7, 41, 75, and 108. The electric hot water heaters in Tower A are in the MERs on Floors 7 and 75. The electric hot water heaters in Tower B are in the MERs on Floors 7, 75, and 108. The electric hot water heaters are connected in parallel to the steam hot water heaters. In general, during May the steam hot water heaters on Floors 7 and 75 in Tower A and on Floors 7, 75, and 108 in Tower B are deactivated and the electric hot water heaters are activated. In general, during October the electric hot water heaters on Floors 7 and 75 in Tower A and on Floors 7, 75, and 108 in Tower B are deactivated and the steam hot water heaters are activated. Thus steam supply to the MERs on Floors 7 and 75 in Tower A and on Floors 7, 75, and 108 is shut off during the May-October period. The steam hot water heaters and the electric hot water heaters are described below.

STEAM HOT WATER HEATERS

General. The basic function of a steam hot water heater is to supply hot water at about 120°F. There are 12 steam hot water heaters in the Domestic Hot Water System in each tower. See

Figure 1.1. All the steam hot water heaters are basically similar. The steam hot water heater (HWH-41-3A, Downfeed) in the Mechanical Equipment Room on Floor 41 of Tower A is described here.

Description. The steam hot water heaters are made by Patterson-Kelly Co. of East Stroudsburg, Pa. They are packaged water heaters, type PK, Control-Flo Series 400. A schematic of the steam hot water heating system is in Figure 3.7. Various views of the steam hot water heater are in Figures 3.8, 3.9, and 3.10. Control components of the steam hot water system are shown in Figures 3.11, 3.12, and 3.13.

Safety Valves. There are 3 safety valves: a water pressure relief valve, an air pressure relief valve, and a hot water bleed valve. These 3 valves are described below:

1. Water Pressure Relief Valve. See Figures 3.7 and 3.9. This valve is identical to the water pressure relief valve for the hot water preheater, which was described earlier in this chapter.
2. Air Pressure Relief Valve. See Figures 3.7 and 3.9. This valve is identical to the air pressure relief valve for the hot water preheater, which was described earlier in this chapter.
3. Hot Water Bleed Solenoid Valve. See Figures 3.7 and 3.8. The basic function of this valve is to bleed hot water to the floor drain if the temperature of the water exceeds 200°F. The solenoid valve is normally closed. This valve is controlled by a thermostat which is set at 200°F. A thermal bulb senses the temperature of the hot water from the hot water heater and this information is fed to the thermostat. When the temperature of the hot water exceeds 200°F, the thermostat (thermal switch) closes and the solenoid associated with the solenoid valve energizes. Now the solenoid valve opens and the hot water drains. When the temperature falls below 200°F, the thermostat opens, the solenoid deenergizes, and the solenoid valve closes.

Steam Supply and Return. Low pressure steam is supplied through a steam control valve. See Figures 3.7 and 3.8. This steam is used for preheating the water, if necessary. In the return line, there is a mixture of steam and condensate. The steam in the return line is converted to condensate in the steam trap. The condensate is fed to the condensate system.

Controls. Controls for the hot water heater include: a temperature controller, a steam control valve, and a control air solenoid valve. These are described below.

1. Temperature Controller. See Figures 3.7 and 3.13. The basic function of the temperature controller is to monitor the temperature of the hot water. The controller is shown in Figure 3.13. The controller is set at 105°F, which is the desired temperature of the hot water. The controller is pneumatic, is made by Honeywell, and is type RP908A 10054.
2. Steam Control Valve. See Figures 3.7 and 3.8. The basic function of the steam control valve is to control the amount of steam admitted into the hot water heater. The valve is normally closed, and is controlled pneumatically by the temperature controller. If the temperature of the hot water is equal to or more than the setting of the temperature controller, the steam control valve is closed and no steam is admitted. If the temperature of the hot water is less than the setting of the temperature controller, the steam control valve opens and steam is admitted until the hot water heats to the setting of the temperature controller.
3. Control Air Solenoid Valve. See Figures 3.7 and 3.13. This valve is normally open and lets control air flow through to control the steam control valve. When the temperature of hot water reaches 120°F, the valve closes, shutting off the control air to the steam control valve.

Also the control air in the line between this valve and the steam control valve is exhausted.

Operation. Water from the preheater is supplied to the heater. If the temperature of water from the preheater is more than 105°F, the water passes through the hot water heater without being heated by the Hot Water Distribution System. If the water temperature from the preheater is less than 105°F, the preheated water is heated in the hot water heater by low pressure steam to about 105°F. Operation of the hot water system is explained in the following paragraphs. See Figure 3.7.

The temperature of heated water in the hot water heater is converted to air pressure, which is fed to (1) in the temperature controller. This air pressure is compared with the setting of the controller, and air pressure proportional to the difference is fed to the branch (B) line of the controller. If the difference is zero, there is no resultant air pressure fed to the branch (B) line, and the steam control valve is closed. If the temperature of hot water is more than the setting of the controller, the resultant air pressure in the branch line tends to close the steam control valve. If the temperature of hot water is less than the setting of the controller, the resultant air pressure in the branch (B) line tends to open the steam control valve, admitting steam to increase the temperature of the hot water.

If the hot water temperature from the water heater exceeds 200°F, the safety thermostat (set at 200°F) closes, the hot water bleed solenoid valve opens, and the hot water drains. Also the control air solenoid valve closes and the control air exhausts from the pipe between the steam control valve and the control air solenoid valve.

ELECTRIC HOT WATER HEATERS

General. There are 4 electric hot water heaters in Tower A and 5 electric hot water heaters in Tower B. The electric hot water heaters are connected in parallel to the steam hot water

heaters. See Figure 1.1. A schematic of the electric hot water heaters is in Figure 3.14.

Heaters - Floor 7 - MER

General. There are 2 electric hot water heaters in the MER in each tower on Floor 7. The 2 heaters are basically similar: only 1 of the heaters is activated during the May-October period; the other serves as a standby. The 2 electric hot water heaters in the MER on Floor 7 in Tower A are shown in Figure 3.15. An interior view of a heater is in Figure 3.16. Thermal and pressure relief valves associated with a heater are shown in Figure 3.17. Electrical schematics associated with the heaters are shown in Figure 3.18.

Nameplate Data. The nameplate data of an electric hot water heater in the MER on Floor 7 in Tower A are presented below:

Model No. DVE52
Series - 810
Serial No. 810-C-80-67377 } for 2 heaters
810-C-80-67378 }
Volts A.C. - 480
Number of Thermal Elements - 9
KW (Each Thermal Element) - 6 KW
Total KW - 54
Total Amps - 64.9
Hertz - 50/60
Phase 3 - Delta
Capacity U.S. Gallons - 50
Working Pressure - 150 PSI
Test Pressure - 300 PSI
(1) Equipped with Manual Reset
High temperature Limit Control
(2) Open switch before replacing fuses
A.O. Smith Corporation
Consumer Products
Kankakee, Ill.

Description. Each heater is equipped with 9 thermal elements: 3 thermal elements in the lower level of the tank, 3 in the middle level of the tank and 3 in the upper level of the tank. A thermostat is associated with each of the 3 thermal elements. Thus there are 3 operating thermostats. See Figures 3.16 and 3.18. The water temperature is controlled by these thermostats whose contacts open when the water temperature reaches the thermostat setting. The thermostat (TS1) associated with the lower level thermal elements is set at 102.5°F. The thermostat (TS2), associated with the middle level thermal elements, is set at 105°F. The thermostat (TS3) associated with the upper level thermal elements, is set at 107.5°F. Each heater is also equipped with a high temperature limit thermostat (TS4) and thermal and pressure relief valves, which are described below:

High Temperature Limit Thermostat. See Figures 3.16 and 3.18. The high temperature limit thermostat is set at 190°F. When the water temperature exceeds 190°F, the contacts of the thermostat, TS4, open to shut off power to all thermal elements. Thus the heater is shut down. The thermostat however must be manually reset after the water temperature drops to 160°F.

Thermal-Pressure Relief Valve. Each heater is equipped with a thermal relief valve and a pressure relief valve. See Figure 3.17. The thermal relief valve is set at a temperature of 210°F and the pressure relief valve is set at a pressure of 150 PSI. When the water temperature exceeds 210°F, the thermal relief valve opens to empty the hot water to the floor drain until the water temperature falls below 210°F. When the pressure in the tank exceeds 150 PSI, the relief valve opens to discharge hot water until the pressure falls below 150 PSI.

Operation. See Figure 3.18. When the water temperature reaches 102.5°F, the contacts of the lower level thermostat open to shut off power to their 3 thermal elements. As the temperature of water reaches 105°F, the contacts of the middle level thermostat

open to shut off power to their 3 thermal elements. As the water temperature reaches 107.5°F, the contacts of the upper level thermostat open to shut off power to their 3 thermal elements. As the water temperature falls below 107.5°F the contacts of the upper level thermostat close to supply power to their 3 thermal elements. As the water temperature falls below 105°F, the contacts of the middle level thermostat close to supply power to their 3 thermal elements. As the water temperature falls below 102.5°F, the contacts of the lower level thermostat close to supply power to their 3 thermal elements.

Power Supply. The heaters operate at 480V, 3ø, 60 HZ. In Tower A, the power is supplied to the heaters from the North Sub-Station via feeder MN7R through a 200A fused disconnect switch (fuse rated for 150A). Each heater receives 480V power through a 100A disconnect switch located at the heater.

In Tower B, 480V power is supplied to the heaters from the West Substation via a 400A disconnect switch at the right switchboard. Each heater receives 480V power through a 100A disconnect switch located at the heater.

Heaters - Floor 75 - MER

General. There are 2 electric hot water heaters in the MER on Floor 75 in each tower. The heaters are basically similar but have different capabilities. One heater is rated at 105 KW and the other is rated at 165 KW. In Tower A, the heater (upfeed) serving Floors 77 to 92 is rated at 105 KW and the heater that serves Floors 74 to 59 (downfeed) is rated at 165 KW. In Tower B, the heater (upfeed) serving Floors 77 to 92 is rated at 165 KW, but the heater (downfeed) serving Floors 74 to 59 is rated at 105 KW. The electric hot water heater arrangement in the MER on Floor 75 of Tower A is shown in Figure 3.14. An exterior and an interior view of the 105 KW water heater are in Figures 3.19 and 3.20. An exterior and an interior view of the 165 KW water heater are in Figures 3.23 and 3.24.

Nameplate Data - 105 KW Heater. The nameplate data of the 105 KW water heater in the MER on Floor 75 are presented below:

Storage Water Heater
Commercial Type
Manufactured by
CAM INDUSTRIES, INC.
18250 68th Ave. South
Kent, Washington 98031

Model No. 150G-348105 TW
Job 83027-1
Manufacturing Date - 2/81
Kilowatts - 105, Volts-480, Amps - 127
PH.-3, Cycles - 60
Serial No. 1120477
Natl. Board No. 20477
Working Pr. 160 psi
Test Pr. 240 psi
Maximum operating Pressure - 160 psi
Maximum operating Temperature - 190°F

Nameplate Data - 165 KW Heater. The nameplate data of the 165 KW water heater in the MER on Floor 75 are presented below:

Storage Water Heater
Commercial Type
Manufactured by
CAM INDUSTRIES INC.
18250 68th Ave. South
Kent, Washington 98031

Model No. 200G - 348165 TW
Job 83027-2
Manufacturing Date - 2/81
Kilowatts - 165 Phase - 3
Volts - 480 Cycles - 60
Amps - 199

Serial No. 1120479

National Board No. 20479

Working Pressure - 160 psi

Test Pressure - 240 psi

Maximum Operating Pressure - 160 psi

Maximum Operative Temperature - 190°F

Description. The 105 KW heater has a capacity of 150 gallons and the 165 KW heater has a capacity of 200 gallons. Except for the gallonage, the 2 heaters are basically similar. The 105 KW heater has 4 thermal elements and the 165 KW heater has 6 thermal elements. An exterior and an interior view of the 105 KW heater are in Figures 3.19 and 3.20, respectively. The electric power and control panel associated with the 105 KW heater is shown in Figure 3.21. A schematic of the 105 KW water heater is in Figure 3.22.

An interior and an exterior view of the 165 KW heater are in Figures 3.23 and 3.24, respectively. The electrical power and control panel associated with the 165 KW heater is shown in Figure 3.25. A schematic of the 165 KW water heater is shown in Figure 3.26.

Each heater is equipped with a Power On lamp, a low-water cutoff device, a low-water cutoff lamp, an operating temperature thermostat, a high temperature limit thermostat (auto reset), a high temperature limit thermostat (manual reset), a pressure relief valve, and power and electrical components. All these are described below:

Power On Lamp (PL1). See Figures 3.19, 3.22, 3.23, and 3.26. This lamp lights to indicate power is applied to the heater. The lamp extinguishes when the power is cut off.

Low-Water Cutoff Device. See Figures 3.20, 3.22, 3.24, and 3.26. Each heater is equipped with an automatic-resetting, electrical low-water cutoff device of the electrode type. The basic function of the low-water cutoff device is to prevent the operation of a heater when the water falls below a predetermined level.

There are a low-water cutoff relay and an electrode on the secondary side of the transformer. When the electrode contacts water, the low-water cutoff relay energizes and its contacts close to light the low-water cutoff lamp. If the water level falls below the electrode, the secondary circuit is broken, the low-water cutoff relay deenergizes, and its contacts open to shut down the heater and extinguish the low-water cutoff lamp.

Low-Water Cutoff Lamp (PL2). See Figures 3.19, 3.22, 3.23, and 3.26. This lamp is normally lit. When the water in the tank falls below a predetermined level, the low-water cutoff lamp extinguishes.

Operating Temperature Thermostat (TS3). See Figures 3.20, 3.22, 3.24, and 3.26. This thermostat determines the water temperature delivered from the heater. This thermostat is set at 105°F. When the water temperature in the heater reaches 105°F, the contacts of thermostat TS3 open to shut off the heater. When the water temperature falls below 105°F, the contacts of thermostat TS3 close to turn on the heater.

High Temperature Limit Thermostat - Auto Reset (TS2). See Figures 3.20, 3.22, 3.24 and 3.26. This thermostat is set at 180°F. As the water temperature reaches 105°F, the contacts of thermostat TS3 should open to shut off the heater but due to a malfunction of TS3, its contacts do not open and the water temperature keeps rising. When the water temperature reaches 180°F, thermostat TS2 opens it contacts and shuts off the heater. When the water temperature falls below 105°F, thermostat TS2 closes its contacts, which automatically turn on the heater.

High Temperature Limit Thermostat - Manual Reset (TS1). See Figures 3.19, 3.22, 3.23 and 3.26. This thermostat is set at 190°F. As the water temperature reaches 105°F, the contacts of thermostat TS3 should open to shut off the heater. However, because of a malfunction, the TS3 contacts do not open, and the water temperature keeps rising. When the water temperature reaches 180°F, the contacts of thermostat TS2 should open to shut off the heater. Again,

due to a malfunction of TS2, its contacts do not open and the temperature keeps rising. When the temperature reaches 190°F, the contacts of high temperature limit thermostat TS1 open to shut down the heater. Even if the water temperature falls below 190°F, the contacts of thermostat TS1 do not close automatically. Thermostat TS1 must be manually reset.

Pressure Relief Valve. Each heater is equipped with a pressure relief valve. See Figure 3.19. The pressure relief valve is set at 160 PSI. When the hot water pressure in the tank exceeds 160 PSI, the pressure relief valve opens to release hot water into the floor drain until the pressure falls below 160 PSI.

Control Power Transformer (TR1). See Figures 3.21, 3.22, 3.25 and 3.26. This transformer steps down 480V to 120V for the control circuit. The transformer is rated at 150 VA for the 105 KW heater and 250 VA for the 165 KW heater.

Fuses (F1, F2). See Figures 3.21, 3.22, 3.25 and 3.26. These fuses are rated at 5A and provide overcurrent and short circuit protection for control power transformers.

Control Power Circuit Breakers (CB1). See Figures 3.22, 3.23, 3.24, and 3.26. The control power circuit breaker provides overcurrent and short circuit protection for the control circuit.

Transformer (TR2). See Figures 3.21, 3.22, 3.25 and 3.26. This transformer is associated with the hot water cutoff device. The transformer steps up 120V to 300V, which are necessary to operate the low-water cutoff device.

Low-Water Cutoff Relay (WLS1). See Figures 3.21, 3.22, 3.25 and 3.26. This relay is normally energized and its contacts are normally closed in order to light the low-water cutoff lamp. When the water level falls below a predetermined level, relay WLS1 deenergizes and its contacts open to extinguish the low-water cutoff lamp.

Transformer (TR3). See Figures 3.21, 3.22, 3.25 and 3.26. This transformer steps down 120V to 24V for the operation of the

time delay sequencer. The transformer is rated at 40 VA.

Time Delay Sequencer (TDS). See Figures 3.21, 3.22, 3.25 and 3.26. The function of the time delay sequencer is to supply power to thermal elements at slightly delayed time intervals to avoid power surges. TDS operates at 24V, which are obtained from transformer TR3.

Contactors (CR1, CR2, CR3, CR4, CR5, CR6). There are 4 contactors (CR1, CR2, CR3, CR4) associated with the 105 KW heater. See Figures 3.21 and 3.22. There are 6 contactors (CR1 thru CR6) associated with the 165 KW heater. See Figures 3.25 and 3.26. When a contactor energizes, its contacts close in order to supply power to its associated thermal elements. When a contactor deenergizes, its contacts open to cut off power to the thermal elements.

Fuses (Thermal Elements). See Figures 3.21, 3.22, 3.25 and 3.26. These fuses provide overcurrent and short circuit protection for thermal elements. The fuses are rated at 50A.

Operation - 105 KW Heater. See Figure 3.22. When power is applied to the heater, the time delay sequencer, TDS, energizes. TDS contacts 3-4 close 15 seconds after TDS energizes. Contactor CR1 energizes and its contacts CR1 close to energize thermal element T-1. TDS contacts 5-6 close 30 seconds after TDS energizes. Contactor CR2 energizes and its contacts CR2 close to energize thermal element T-2. TDS contacts 7-8 close 45 seconds after TDS energizes. Contactors CR3 and CR4 energize and their respective contacts CR3 and CR4 close to energize thermal elements T-3 and T-4. When the water temperature reaches 105°F, thermostat contacts TS-3 open to shut off control power to time delay sequencer TDS and to contactors CR1, CR2, CR3 and CR4. Contactors CR1, CR2, CR3 and CR4 deenergize and their contacts open to shut off power to thermal elements T-1, T-2, T-3 and T-4. Time delay sequencer TDS deenergizes and its contacts 3-4, 5-6, and 7-8 open.

Operation - 165 KW Heater. See Figure 3.26. When power is

applied to the heater, time delay sequencer TDS energizes. TDS contacts 3-4 close 15 seconds after TDS energizes. Contactors CR1 and CR2 energize and their contacts close to energize thermal elements T-1 and T-2. TDS contacts 5-6 close 30 seconds after TDS energizes. CR3 and CR4 energize and their contacts close to energize thermal elements T-3 and T-4. TDS contacts 7-8 close 45 seconds following the energizing of TDS. Contactors CR5 and CR6 energize and their contacts close and energize thermal elements T-5 and T-6.

When the water temperature reaches 105°F, thermostat contacts TS-3 open to shut off control power to time delay sequencer TDS and to contactors CR1 thru CR6. Contactors CR1 thru CR6 deenergize and their contacts open to shut off power to thermal elements T-1 thru T-6. Time delay sequencer TDS deenergizes and its contacts 3-4, 5-6, and 7-8 open.

Power Supply. The 105 KW and 165 KW heaters operate at 480V, 3Ø, 60 HZ. In Tower A, 480V power is supplied from the North Substation via unit L5 on the left switchboard through a 400A fused disconnect switch (fuse rated at 400A). 480V power is supplied to the 105 KW heater via a 150A circuit breaker at the heater. 480V power is supplied to the 165 KW heater via a 225A circuit breaker at the heater.

In Tower B, 480V power is supplied from the left switchboard in the West Substation via a 400A fused disconnect switch (fused for 400A). 480V power is supplied to the 105 KW heater via a 150A circuit breaker at the heater. 480V power is supplied to the 165 KW heater via a 400A fused disconnect switch (fused at 400A).

Heater - Floor 108 - MER - Tower B

Description. There is 1 electric hot water heater in the MER on Floor 108 in Tower B. This heater is basically similar to the electric hot water heaters in the MER on Floor 75. The heater is rated at 120 KW and has a capacity of 200 gallons. The heater serves Floors 107 to 93 in Tower B. See Figure 1.1. A schematic of the heater is in Figure 3.27. The power and control components associated with the 120 KW heater are basically similar to those for the 105 KW heaters described above.

Nameplate Data - 120 KW Heater. The nameplate data for the 120 KW water heater in the MER on Floor 108 in Tower B are presented below:

Storage Water Heater
Commercial Type
Manufactured by:
CAM INDUSTRIES, INC.
18250 68th Ave. South
Kent, Washington 98031
Model No. 200G-348120 TW
Job 24954-1
Manufacturing Date - 5/83
Kilowatts - 120 Volts - 480 Amps - 145
PH. - 3 Cycles - 60
Serial No. H21842
Natl. Board No. 21842
Working Pr. - 150 PSI
Test Pr. - 225 PSI
Maximum Operating Pressure - 125 PSI
Maximum Operating Temperature - 190°F

Operation - 120 KW Heater. See Figure 3.27. When power is applied to the heater, the time delay sequencer TDS energizes. TDS contacts 3-4 close 15 seconds after TDS energizes. Contactor CR1 energizes and its contacts CR1 close to energize thermal element T-1. TDS contacts 5-6 close 30 seconds after TDS energizes. Contactor CR2 energizes and its contacts CR2 close to energize thermal element T-2. TDS contacts 7-8 close 45 seconds after TDS energizes. Contactor CR3 energizes and its contacts CR3 close to energize thermal element T-3. TDS auxiliary contacts close 60 seconds after TDS energizes. Contactor CR4 energizes and its contacts CR4 close to energize thermal element T-4.

When the water temperature reaches 105°F, thermostat contacts

TS-3 open to shut off control power to time delay sequencer TDS and to contactors CR1, CR2, CR3, and CR4. Contactors CR1, CR2, CR3, and CR4 deenergize and their contacts open to shut off power to thermal elements T-1, T-2, T-3, and T-4. Time delay sequencer TDS deenergizes and its contacts 3-4, 5-6, 7-8, and auxiliary contact open.

Power Supply. The 120 KW heater operates at 480V, 3Ø, 60 HZ. This 480V power is supplied from the West Substation via fused disconnect switch R5 (fuse rated at 200A). The heater receives 480V power through a 100A disconnect switch located at the heater.

HOT WATER CIRCULATING PUMPS

The basic function of the hot water circulating pumps is to circulate hot water through the Hot Water Distribution System so that the water is hot when it is delivered. Hot water circulating pumps Nos. 3 are associated with the hot water heaters Nos. 3 described earlier in this chapter. There are altogether 12 hot water circulating pumps in each tower. The hot water circulating pumps Nos. 3 and their associated motors and starters are shown in Figure 3.28.

CHAPTER 4

DOMESTIC WATER DISTRIBUTION

GENERAL

This chapter deals with Domestic Cold and Hot Water Distribution in Towers A and B. There are 6 zones in the Domestic Water Distribution System in each tower. Each zone has cold water and hot water distribution lines, hot water recirculation lines, and associated shutoff and control valves. For each zone, a distribution riser diagram is presented, and the locations of main shutoff valves and hot water circulation system valves are shown. Also, the locations of wet columns are presented for each zone. A legend of symbols used in the diagrams in this chapter is presented in Figure 4.1.

WATER DISTRIBUTION - ZONE 1

In the Water Distribution System, Zone 1 covers Floors 2 through 24. Figure 4.1a shows the domestic water distribution for Zone 1. Main isolation valves and Hot Water Circulation System valves for Zone 1 are presented in Figures 4.2 and 4.3, respectively. The wet column locations for Zone 1 are shown in Figures 4.4, 4.5, and 4.6.

WATER DISTRIBUTION - ZONE 2

In the Water Distribution System, Zone 2 covers Floors 25 through 40. The domestic water distribution diagram for Zone 2 is presented in Figure 4.7. The locations of main isolation valves for Zone 2 are shown in Figure 4.8. The Hot Water Circulation System valves for Zone 2 are presented in Figures 4.9 and 4.10. The locations of wet columns in Zone 2 are presented in Figures 4.11 and 4.12.

WATER DISTRIBUTION - ZONE 3

In the Water Distribution System, Zone 3 covers Floors 43 through 58. The domestic water distribution diagram for Zone 3 is presented in Figure 4.13. The locations of main isolation valves for Zone 3 are shown in Figures 4.14 and 4.15. The Hot Water Circulation System valves for Zone 3 are presented in Figures 4.15 and 4.16. The locations of wet columns in Zone 3 are presented in Figures 4.17 through 4.21.

WATER DISTRIBUTION - ZONE 4

In the Water Distribution System, Zone 4 covers Floors 59 through 74. The domestic water distribution diagram for Zone 4 is presented in Figure 4.22. The locations of main isolation valves for Zone 4 are shown in Figure 4.23. The Hot Water Circulation System valves for Zone 4 are presented in Figures 4.24 and 4.25. The locations of wet columns in Zone 4 are presented in Figures 4.26 through 4.29.

WATER DISTRIBUTION - ZONE 5

In the Water Distribution System, Zone 5 covers Floors 77 through 92. The domestic water distribution diagram for Zone 5 is presented in Figure 4.30. The locations of main isolation valves for Zone 5 are shown in Figure 4.31. The locations of Hot Water Circulation System valves for Zone 5 are presented in Figure 4.32. The locations of wet columns in Zone 5 are presented in Figures 4.33 through 4.41.

WATER DISTRIBUTION - ZONE 6

In the Water Distribution System, Zone 6 covers Floors 93 through 107. The domestic water distribution diagram for Zone 6 is presented in Figure 4.42. The locations of main isolation valves for Zone 6 are presented in Figure 4.43. The locations of Hot Water Circulation System valves for Zone 6 are presented in Figures 4.44 and 4.45. The locations of wet columns in Zone 6 are presented in Figures 4.46 through 4.51.

CHAPTER 5

SYSTEM MAINTENANCE

SCOPE

This chapter presents procedures and schedules for maintenance of the domestic water equipment in Towers A and B at the World Trade Center (WTC).

GENERAL

Procedures and schedules for maintenance of the domestic water equipment at the WTC have been developed by the Operations Standards Division of the Management Services Department.

MAINTENANCE PROCEDURE CARDS

Maintenance procedures and schedules developed by the Operations Standards Division are outlined in the Maintenance Procedure Cards (MPCs). MPCs applicable to the domestic water equipment are presented on the following pages.

DOMESTIC COLD WATER SYSTEM

MPCs applicable to the equipment associated with the Domestic Cold Water System are presented on Pages 5.2 thru 5.6.

DOMESTIC HOT WATER SYSTEM

MPCs applicable to the equipment associated with the Domestic Hot Water System are presented on Pages 5.7 thru 5.11.

DOMESTIC WATER PUMP CONTROLS

Maintenance work to be performed on the Domestic Water Pump Controls and its frequency are presented on Page 5.12.

MPC #: M-60

Work to be done: Service Backflow Preventor Rig

Frequency: Y-1

Description:

1. Secure system.
2. Inspect all piping and fittings for corrosion or leakage.
3. Lubricate valve stems with non-gumming lubricant.
4. Take in on gland nuts if valve is leaking excessively. Repack if required.
5. Exercise all manual valves by turning screw through full range at least 5 times.
6. Inspect check valve for leakage.
7. Clean strainer thoroughly. Lubricate cover with non-gumming lubricant.
8. Test low pressure alarm for proper operation.
9. Report any deficiencies to foreman verbally and in writing.
10. Consult manufacturers specifications for particular equipment requirements before performing any maintenance work.

MPC #: M-53

Work to be done: Service House Water Pump

Frequency: Y-1

Description:

1. Check bearings for noise and report unusual circumstances to foreman verbally and in writing.

2. Check leakage at packing gland and adjust if required (if applicable).

3. On those pumps with mechanical seals, inspect seals for excessive wear or leakage.

4. Deactivate pump and close intake and discharge valves.

5. Remove strainers and clean thoroughly. Lubricate cover fittings with non-gumming lubricant and reassemble using new gaskets if required.

6. Remove gauges and clean all gauge glasses. Replace those which may be broken or cracked.

7. Place gauge on tester and recalibrate if required.

8. Lubricate gauge fittings with non-gumming lubricant and replace gauges.

9. Take in on gland nuts if valves are leaking excessively, repack if required.

10. Lubricate valve stems and screws sparingly with non-gumming lubricant.

11. Inspect pump-motor couplings for excessive wear, replace worn parts if required (if applicable).

12. Check pump-motor alignment with dial indicator.

13. Exercise manually operated valves.

14. Wire brush and spot paint valve bodies wherever necessary.

15. Place pump back on line.

16. Report any deficiencies to foreman verbally and in writing.

17. Consult manufacturer's specifications for particular equipment requirement before performing any maintenance work.

MCP #: M-54

Work to be done: Overhaul house water pump

Frequency: 5-Y

Description:

1. Deactivate system and close suction and discharge valves.

2. Remove check valve and bolts connecting pump to suction and discharge piping.

3. Use rust buster liberally on all threaded areas.

4. If pump has flexible connections, take up on bolts to ease difficulty of removal.

5. Jacks may be required to maintain alignment of piping during removal and reinstallation.

Close Coupled Pumps

1. Remove gland nuts and slide cover back on shaft (if applicable).

2. Remove bolts, coupling pump housing and motor housing.

3. Remove packing (if applicable)

4. Ease pump housing off. Use plastic mallet if housing is stuck, being careful not to damage impeller.

5. Remove impeller key and shaft sleeve from shaft.

6. Inspect sleeve, impeller, wear rings and shafts for serious wear, binding, pitting, misalignment or signs of imbalance.

7. Inspect check valve seat and spring for wear and tension.

8. Inspect interior of pump housing and all parts.

Split Case Pumps

1. Repeat steps 1 through 4 above.
2. Break pump-motor coupling and renew worn parts as required.
3. Remove pump head and bearing plates.
4. Loosen gland nuts and remove old packing (if applicable).
5. Open check valve and inspect.

MCP #: M-54 (Cont.)

6. Renew worn or faulty parts.
7. Check axial and parallel alignment with dial indicator (where applicable).
8. Reassemble pump and place back on line and test run.
9. Paint pump and pipe connections with Cromate or inert paint. Do not paint any threaded or brass fittings.
10. Report any deficiencies to Foreman verbally and in writing.
11. Consult manufacturer's specifications for particular equipment requirements before performing any maintenance work.

MPC #: M-59

Work to be done: Flush Pneumatic Cushion Tank

Frequency: Y-1

Description:

1. Inspect tank for leaks, seepage or structural flaws.

2. Inspect all piping and pipe fittings for corrosion or leakage.

3. Deactivate solenoid valves and drain cushion tank to remove sediment, scale or residue.

4. Clean strainer and replace.

5. Clean all gauge glasses and, if required, replace those which may be cracked or broken.

6. Test gauge and, if necessary, adjust for proper calibration.

7. Lubricate gauge fittings sparingly with non-gumming lubricant and replace.

8. Check high and low pressure alarms for proper operation.

9. Reactivate system.

10. Check relief valves to insure proper operation.

11. Report any deficiencies to foreman verbally and in writing.

12. Consult manufacturer's specifications for particular equipment requirements before performing any maintenance work.

MPC #: M-55

Work to be done: Service Preheater

Frequency: Y-1

Description:

1. Deactivate system and close inlet and outlet valves on heater.
2. Remove strainer and clean thoroughly. Lubricate cover and fittings with non-gumming lubricant and reassemble using new gaskets.
3. Clean dirt pockets.
4. Clean all thermometers and replace those which may be broken or cracked.
5. Adjust or repack inlet and outlet valves if required.
6. Clean all gauge glasses and, if required, replace those which may be cracked or broken.
7. Test gauge and adjust for proper calibrations if necessary.
8. Lubricate gauge fittings sparingly with non-gumming lubricant and reinstall.
9. Reactivate systems and check operation.
10. Check relief valves to insure proper operation. (if applicable).
11. Report any deficiencies to foreman verbally and in writing.
12. Consult manufacturer's specifications for particular equipment requirement before performing any maintenance work.

Tools & Equipment

1. "Standard" tool kit (screwdriver, pliers, etc.)
2. Gauge tester & needle puller
3. Gasket cutter

Materials

1. Lubricant (non-gumming)
2. Spare thermometer glasses
3. Gasket material (asbestos type)
4. Packing material (refer to supervisor)
5. Spare thermometers
6. Rags

MPC #: M-56

Work to be done: Overhaul Preheater

Frequency: 5-Y

Description

1. Deactivate system and close inlet valves, drain shell and tubes and expose tubes.

2. Inspect interior and clean tubes with proper cleaning devices such as compressed air gun and brushes, or similar units.

3. Inspect tube exterior and clean.

4. Scrape, wire brush and paint water box interior and division plates with two coats of inert paint.

5. Renew all gaskets and reassemble heater.

6. Clean all gauge glasses and, if required, replace those which may be cracked or broken.

7. Test gauges and adjust for proper calibration, if required.

8. Lubricate gauge fittings sparingly with non-gumming lubricant and reinstall.

9. Restore system to normal operation and check.

10. Report any deficiencies to foreman verbally and in writing.

11. Consult manufacturer's specifications for particular equipment requirements before performing any maintenance work.

Tools & Equipment

1. Compressed air gun
2. Tube brushes
3. Paint scraper (2)
4. Wire brush
5. Drain hose
6. Heavy duty pipe wrench
7. Gasket cutter
8. Gauge tester
9. Extension cord
10. Adjustable wrench - 10"
11. Open-end or box wrenches
12. "Standard" tool kit (screwdriver, pliers, etc.)
13. Socket wrench (½" drive), socket and power drill

Materials

1. Paint (refer to supervisor)
2. Gasket material (asbestos type)
3. Gauge glasses (spare)
4. Lubricant (non-gumming)
5. Paint brushes (2-3")

MPC#: M-51

Work to be done: Service Hot Water Heater

Frequency: Y-1

Description:

1. Secure system by closing inlet and outlet valves on HW heater.
2. Remove strainer and clean thoroughly. Lubricate cover and fittings with non-gumming lubricant and reassemble using new gaskets.
3. Clean dirt pockets and check trap with pyrometer. Rebuild if required.
4. Check all thermostats and thermometers and replace those of which may be broken or cracked.
5. Adjust or calibrate thermostats and aquastats if required.
6. Repack inlet and outlet valves if required.
7. Inspect air vent.
8. Reactivate system.
9. Check relief valves to insure proper operation.
10. Check steam traps at end of steam minifold servicing hot water heaters. Rebuild if required.
11. Consult manufacturer's specifications for particular equipment requirements before performing any maintenance work.
12. Report any deficiencies to foreman verbally and in writing.

Tools & Equipment

1. Wire brush
2. "Standard" tool kit (screwdriver, pliers, etc.)
3. Adjustable wrench (6" - 10")
4. Gasket cutter
5. pyrometer

Materials

1. Non-gumming lubricant
2. Gasket material (asbestos type)
3. Spare thermometer glasses
4. Rags
5. Spare thermostats and thermometers
6. Packing material (refer to supervisor)
7. Steam Trap Rebuilding Kit

MPC #: M-52

Work to be done: Overhaul Hot Water Heater

Frequency: 5-Y

Description:

1. Secure inlet and outlet valves, drain shell and tubes and expose tubes.
2. Inspect shell interior and clean outside of tubes using thermal shock method.
3. Scrape, wire brush and paint shell interior with two coats of inert paint.
4. Reassemble heater using new gaskets.
5. Clean dirt pockets and strainers and check traps.
6. Clean all gauge glasses and replace those of which may be cracked.
7. Remove gauges, place on tester and recalibrate if required.
8. Lubricate gauge fittings with non-gumming lubricant and replace.
9. Restore system to normal operation.
10. Report any deficiencies to foreman verbally and in writing.
11. Consult manufacturer's specifications for particular equipment requirements before performing any maintenance work.

Tools & Equipment	Materials
1. Paint scraper (2)	1. Paint (refer to supervisor)
2. Wire brush	2. Gasket material (asbestos type)
3. Gauge tester	3. Spare gauge glasses
4. "Standard" tool kit (screwdriver, pliers etc.)	4. Lubricant (non-gumming)
5. Gasket cutter	

MPC #: M-61

Work to be done: Service Hot Water Circulating Pump

Frequency: Y-1

Description:

1. Check bearings for noise and report unusual circumstances to foreman verbally and in writing.
2. Put standby pump on the line, close suction and discharge valves on pump to be serviced.
3. Check leakage at packing gland and adjust if leakage is excessive (if applicable).
4. On those pumps with mechanical seals, inspect seals for excessive wear and leakage.
5. Check valve gland leakage and adjust, repack if required.
6. Lubricate valve stems with non-gumming lubricant.
7. Clean all gauge glasses and replace those which may be broken.
8. Remove gauges and test, recalibrate if required.
9. Lubricate gauge fittings sparingly with non-gumming lubricant.
10. Exercise manual valves.
11. Place pump back on line and proceed to service standby pump.
12. Report any deficiencies to foreman verbally and in writing.
13. Consult manufacturer's specifications for particular equipment requirements before performing any maintenance work.

Tools & Equipment	Materials
1. Gauge tester	1. Lubricant (non-gumming)
2. "Standard" tool kit (screwdriver, pliers, etc.)	2. Gauge glasses (spare)
3. Adjustable wrench (6"-10")	3. Rust buster lubricant
	4. Packing material (refer to supervisor)
	5. Rags

Domestic Water Pump Controls

Maintenance work to be performed on the Domestic Water Pump Controls and its frequency is as follows:

Work To Be Performed	*Frequency*
Clean, inspect, and test Domestic Water Supply Pump Controls and Motor	Twice per year
Test Domestic Water Supply Pump Motor Overload Protection	Once per year
Check and tune IKOR Systems and change lead pumps.	Once per month

Figure

1.1 Domestic Water System Diagram
Towers A and B

2.1 Schematic Diagram - Water Intake System
Pump Room - Level B1 - Tower A

2.2 Components
Water Intake System

2.3 Water Meter

2.4 Low Pressure Switch

2.5 Backflow Preventer

2.6 Schematic Diagram
Backflow Preventer

2.7 Schematic Diagram
Pumping Arrangement
MER-Floor 41 - Tower A

2.8 Pumping Arrangement
View 1

2.9A Individual Pump Arrangement
View 1

2.9B Pumping Arrangement
View 2

2.10A Nameplate Data - Pumps - Tower A
Pumping Station No. 1
Level B1 (294')

2.10B Nameplate Data - Pumps - Tower A
Pumping Station No. 2
MER, Floor 41

2.10C Nameplate Data - Pumps - Tower A
Pumping Station No. 3
MER, Floor 75

Figure

2.10D Nameplate Data - Pumps - Tower B
Pumping Station No. 1
Level B1 (294')

2.10E Nameplate Data - Pumps - Tower B
Pumping Station No. 2
MER, Floor 41

2.10F Nameplate Data - Pumps - Tower B
Pumping Station No. 3
MER, Floor 75

2.11 Schematic Diagram - Mechanical Controls
MER - Floor 41 - Tower A

2.12 Mechanical Controls

2.13 Air Cushion Tank
View 1

2.14 Air Cushion Tank
View 2

2.15 Air Cushion Tank
View 3

2.16 Pressure Switches and Transducers

2.17A Interconnection Diagram
Master and Individual Pump Controllers

2.17B Master Controller and Pump Controllers
Pumping Station No. 2

2.18 Control Panel - Front View
Master Controller

2.19 Control Panel - Rear View
Master Controller

2.20 Master Controller
Interior View

Figure	
2.21a and 2.21b	Schematic Diagram Master Controller
2.22A thru 2.22C	Legend Master Controller
2.23	Control Panel - Front View Individual Pump Controller
2.24	Control Panel - Rear View Individual Pump Controller
2.25	Individual Pump Controller Interior View 1
2.26	Individual Pump Controller Interior View 2
2.27	Schematic Diagram Individual Pump Controller
2.28A and 2.28B	Legend Individual Pump Motor Controller
2.29	Schematic Diagram Master and Individual Pump Controllers
2.30	Schematic Diagram - Pressure Reducing Valve Station - MER - Floor 41 - Tower A
2.31	Pressure Reducing Valve Station Overall View
2.32	Pressure Reducing Valve Station Partial View 1
2.33	Pressure Reducing Valve Station Partial View 2
2.34	Pressure Reducing Valve Station Partial View 3

Figure

2.35 Pressure Reducing Valve Station
Partial View 4

2.36 Pressure Reducing Valve Station
Partial View 5

2.37 Schematic Diagram
Pressure Reducing Valve

2.38 Typical Pressure Reducing Valve

2.39 Schematic Diagram
Excess Pressure Control Valve

2.40 Typical Excess Pressure Control Valve

2.41 Schematic Diagram
Pressure Relief Control Valve

2.42 Typical Pressure Relief Control Valve

3.1 Schematic - Hot Water Preheater
MER - Floor 41 - Tower A

3.2 Hot Water Preheater
View 1

3.3 Hot Water Preheater
View 2

3.4 Condensate Supply Header

3.5 Three-Way Mixing Valve And
Temperature-Pressure Transducer

3.6 Temperature Controller
Hot Water Preheater

3.7 Schematic Diagram - Steam Hot Water
Heater - MER - Floor 41 - Tower A

3.8 Steam Hot Water Heater
View 1

Figure

3.9 Steam Hot Water Heater
View 2

3.10 Steam Hot Water Heater
View 3

3.11 Steam Hot Water Heater Controls-1

3.12 Steam Hot Water Heater Controls-2

3.13 Steam Hot Water Heater Controls-3

3.14 Electric Hot Water Heater Arrangements
Floors 7 and 75 - MERs

3.15 Electric Hot Water Heaters
Floor 7 - MER

3.16 Electric Hot Water Heater
Interior View - Floor 7 - MER

3.17 Thermal and Pressure Relief Valves
Electric Hot Water Heaters - Floor 7 - MER

3.18 Schematic Diagrams
Electric Hot Water Heaters - Floor 7 - MER

3.19 Electric Hot Water Heater
105 KW - Floor 75 - MER

3.20 Electric Hot Water Heater - 105 KW
Interior View - Floor 75 - MER

3.21 Electric Power and Control Panel
Electric Hot Water Heater - 105 KW

3.22 Schematic Diagram - Electric Hot Water
Heater - 105 KW - Floor 75 - MER

3.23 Electric Hot Water Heater
165 KW - Floor 75 - MER

Figure

3.24 Electric Hot Water Heater - 165 KW
Interior View - Floor 75 - MER

3.25 Electric Power and Control Panel
Electric Hot Water Heater - 165 KW

3.26 Schematic Diagram - Electric Hot Water
Heater - 165 KW - Floor 75 - MER

3.27 Schematic - Electric Hot Water Heater
120 KW - Floor 108 - MER - Tower B

3.28 Hot Water Circulating Pumps

4.1 Legend
Domestic Water Distribution System

4.1a Domestic Water Distribution Diagram
Zone 1 - Floors 2 thru 24 - Towers A & B

4.2 Main Isolation Valves - Zone 1
Mechanical Equipment Room - Floors 7 & 8

4.3 Hot Water Circulation System Valves
Zone 1 - Floor 24

4.4 Wet Column Locations
Zone 1 - Floors 2 thru 6

4.5 Wet Column Locations
Zone 1 - Floors 7 thru 18

4.6 Wet Column Locations
Zone 1 - Floors 19 thru 24

4.7 Domestic Water Distribution Diagram
Zone 2 - Floors 25 thru 40 - Towers A & B

4.8 Main Isolation Valves - Zone 2
Mechanical Equipment Room - Floor 41

4.9 Hot Water Circulation System Valves
Zone 2 - Floor 25

4.10 Hot Water Circulation System Valves
Zone 2 - Floor 40

Figure

4.11 Wet Column Locations - Zone 2
Floors 25 thru 32

4.12 Wet Column Locations - Zone 2
Floors 33 thru 40

4.13 Domestic Water Distribution Diagram
Zone 3 - Floors 43 thru 58 - Towers A & B

4.14 Main Isolation Valve Locations
Zone 3 - Mechanical Equipment Room
Floors 41 & 42

4.15 Main Isolation & Hot Water
Circulation Valves - Zone 3
Floor 43

4.16 Hot Water Circulation System Valves
Zone 3 - Floor 58

4.17 Wet Column Locations - Zone 3
Floors 41 & 42

4.18 Wet Column Locations - Zone 3
Floor 43

4.19 Wet Column Locations - Zone 3
Floors 44 & 45

4.20 Wet Column Locations - Zone 3
Floors 46 thru 54

4.21 Wet Column Locations - Zone 3
Floors 55 thru 58

4.22 Domestic Water Distribution Diagram
Zone 4 - Floors 59 thru 74 - Towers A & B

4.23 Main Isolation Valve Locations
Zone 4 - Mechanical Equipment Room
Floors 75 & 76

Figure

4.24 Hot Water Circulation System Valves
Zone 4 - Floor 59

4.25 Main Isolation & Hot Water
Circulation System Valves
Zone 4 - Floor 74

4.26 Wet Column Locations - Zone 4
Floors 59, 60, & 61

4.27 Wet Column Locations - Zone 4
Floors 62 & 63

4.28 Wet Column Locations - Zone 4
Floors 64, 65, & 66

4.29 Wet Column Locations - Zone 4
Floors 67 thru 74

4.30 Domestic Water Distribution Diagram
Zone 5 - Floors 77 thru 92 - Towers A & B

4.31 Main Isolation Valve Locations
Zone 5 - Mechanical Equipment Room
Floors 75 & 76

4.32 Hot Water Circulation System Valves
Zone 5 - Floor 92

4.33 Wet Column Locations - Zone 5
Floor 75

4.34 Wet Column Locations - Zone 5
Floor 76

4.35 Wet Column Locations - Zone 5
Floor 77

4.36 Wet Column Locations - Zone 5
Floor 78

4.37 Wet Column Locations - Zone 5
Floor 79

Figure

4.38 Wet Column Locations - Zone 5
Floors 80 & 81

4.39 Wet Column Locations - Zone 5
Floor 82

4.40 Wet Column Locations - Zone 5
Floors 83 thru 86

4.41 Wet Column Locations - Zone 5
Floors 87 thru 92

4.42 Domestic Water Distribution Diagram
Zone 6 - Floors 93 thru 107 - Towers A & B

4.43 Main Isolation Valve Locations
Zone 6 - Mechanical Equipment Room
Floors 108 & 109

4.44 Hot Water Circulation System Valves
Zone 6 - Floor 107

4.45 Hot Water Circulation System Valves
Zone 6 - Floor 93

4.46 Wet Column Locations - Zone 6
Floor 93

4.47 Wet Column Locations - Zone 6
Floors 94 thru 103

4.48 Wet Column Locations - Zone 6
Floors 103 & 104

4.49 Wet Column Locations - Zone 6
Floor 105

4.50 Wet Column Locations - Zone 6
Floors 106 & 107

4.51 Wet Column Locations - Zone 6
Floors 108 & 109

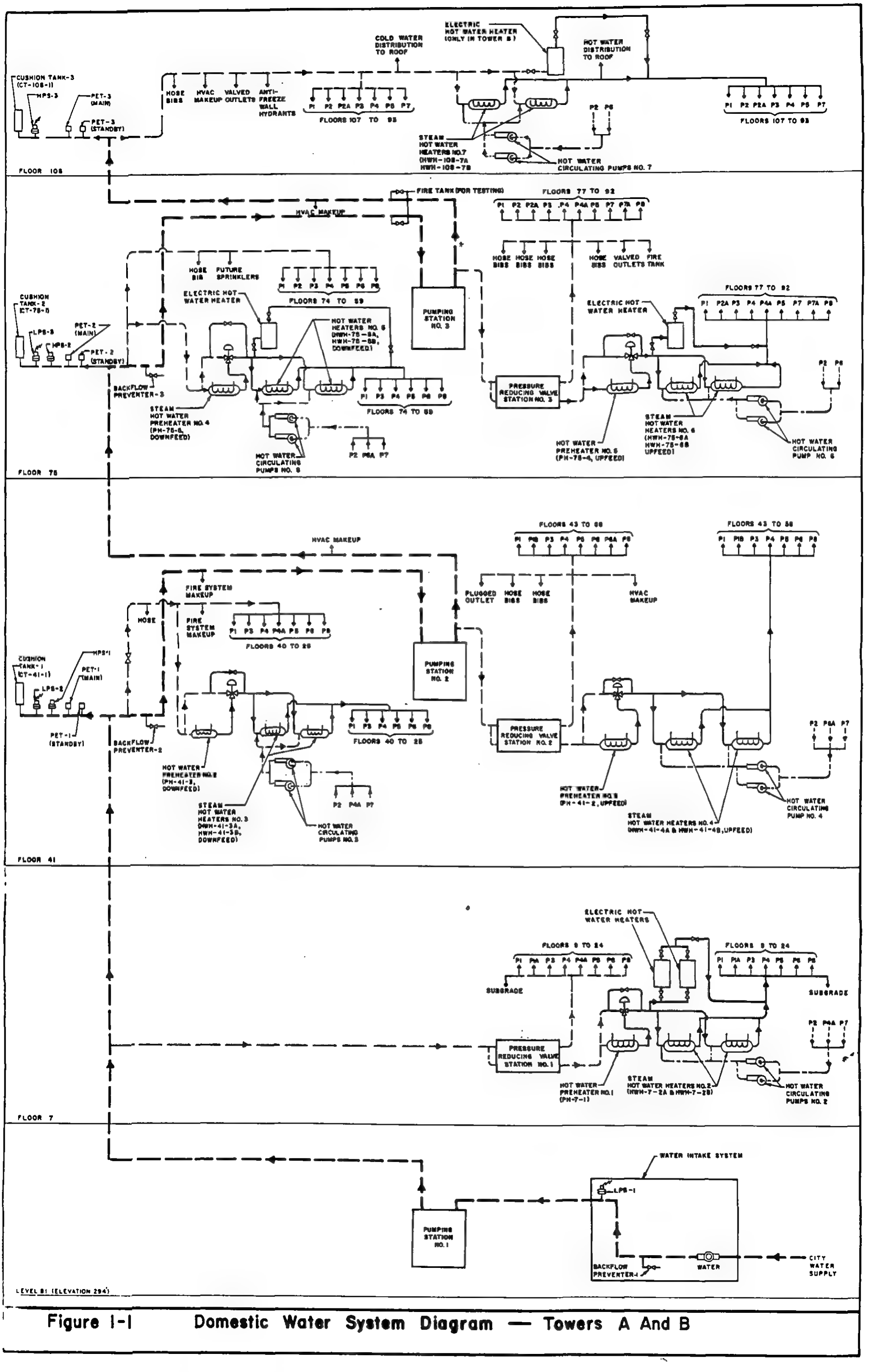


Figure 1-1 Domestic Water System Diagram — Towers A And B

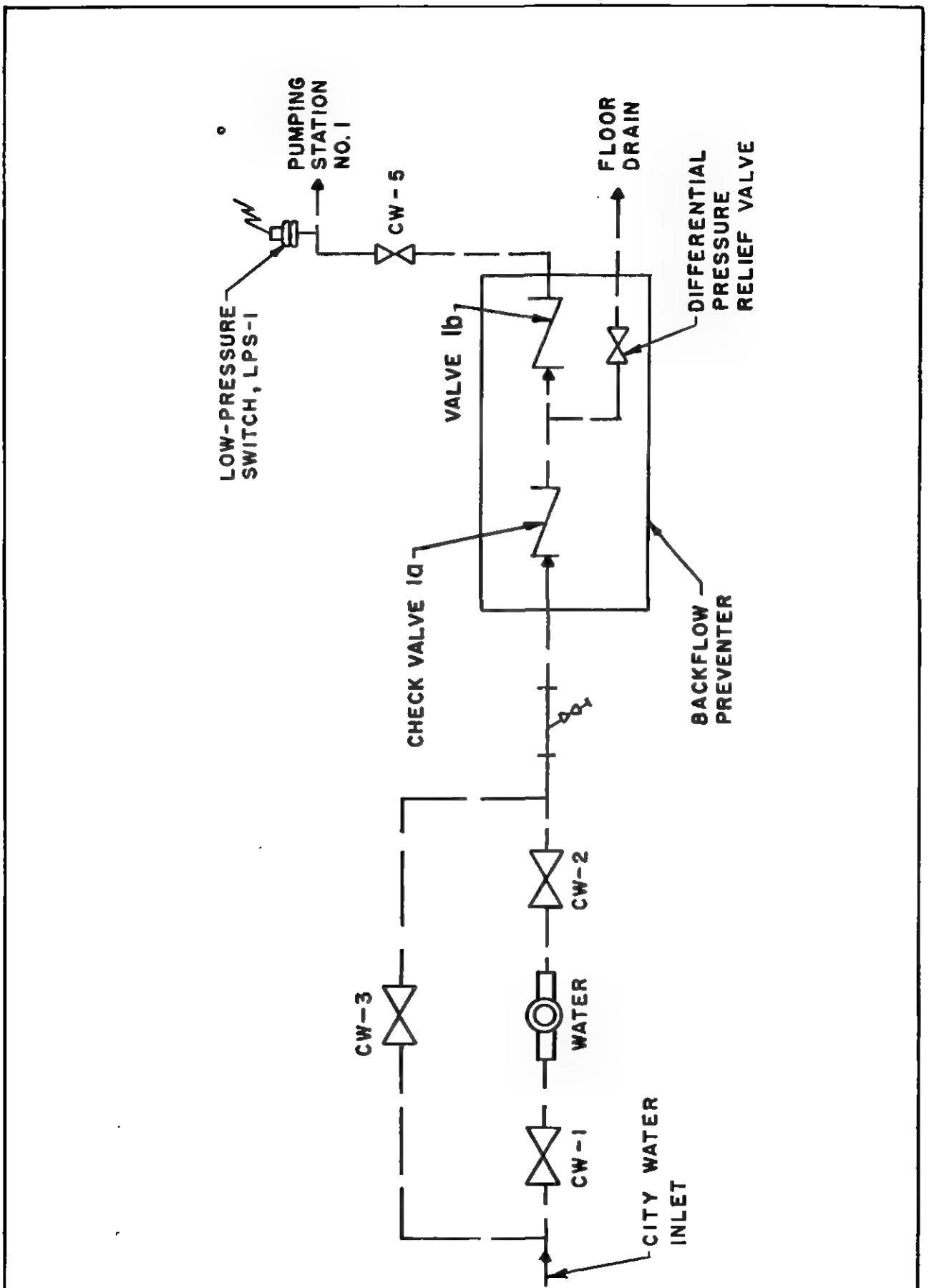


Figure 2-1 Schematic Diagram – Water Intake System
Pump Room – Level B1 – Tower A

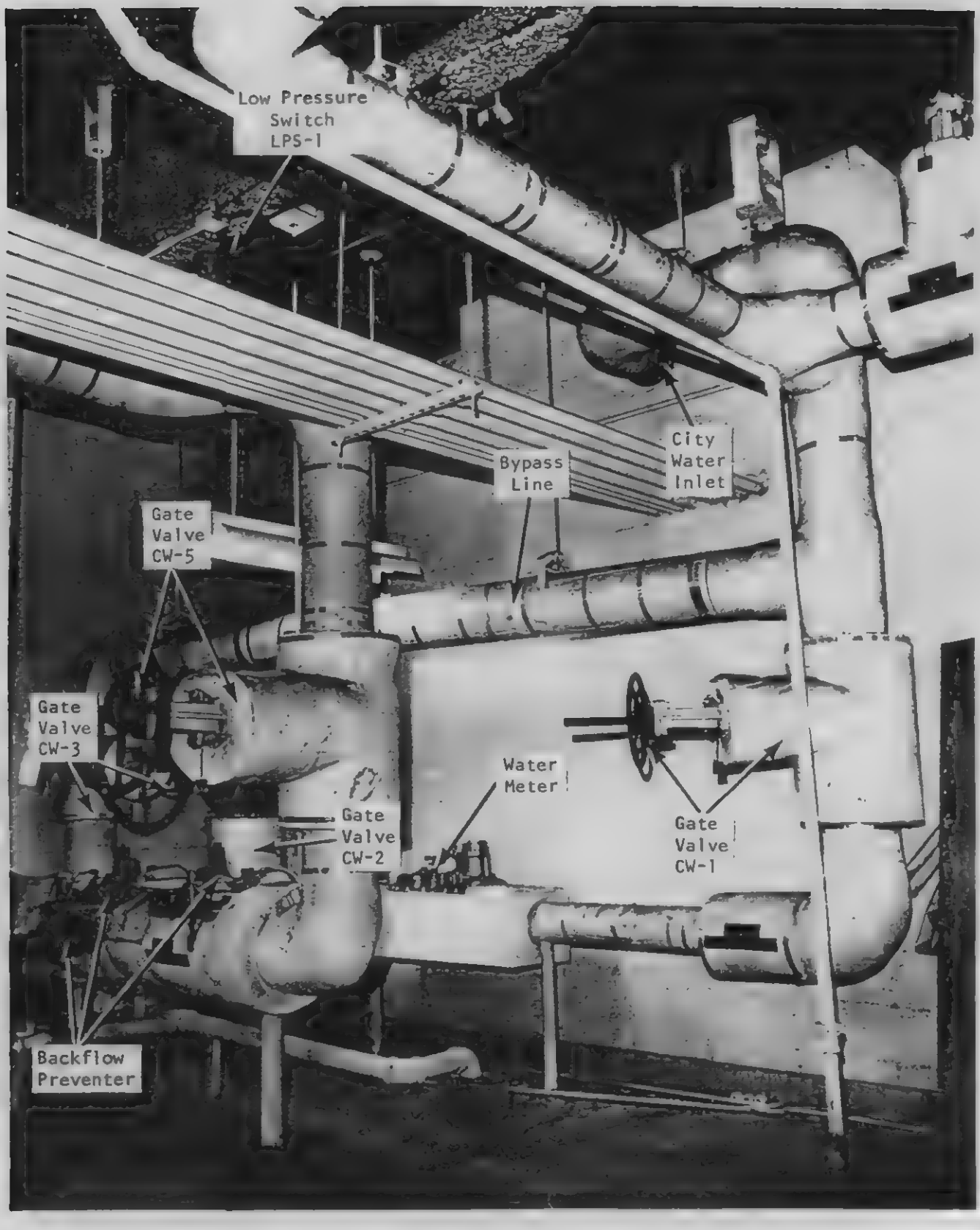


Figure 2.2 Components
Water Intake System

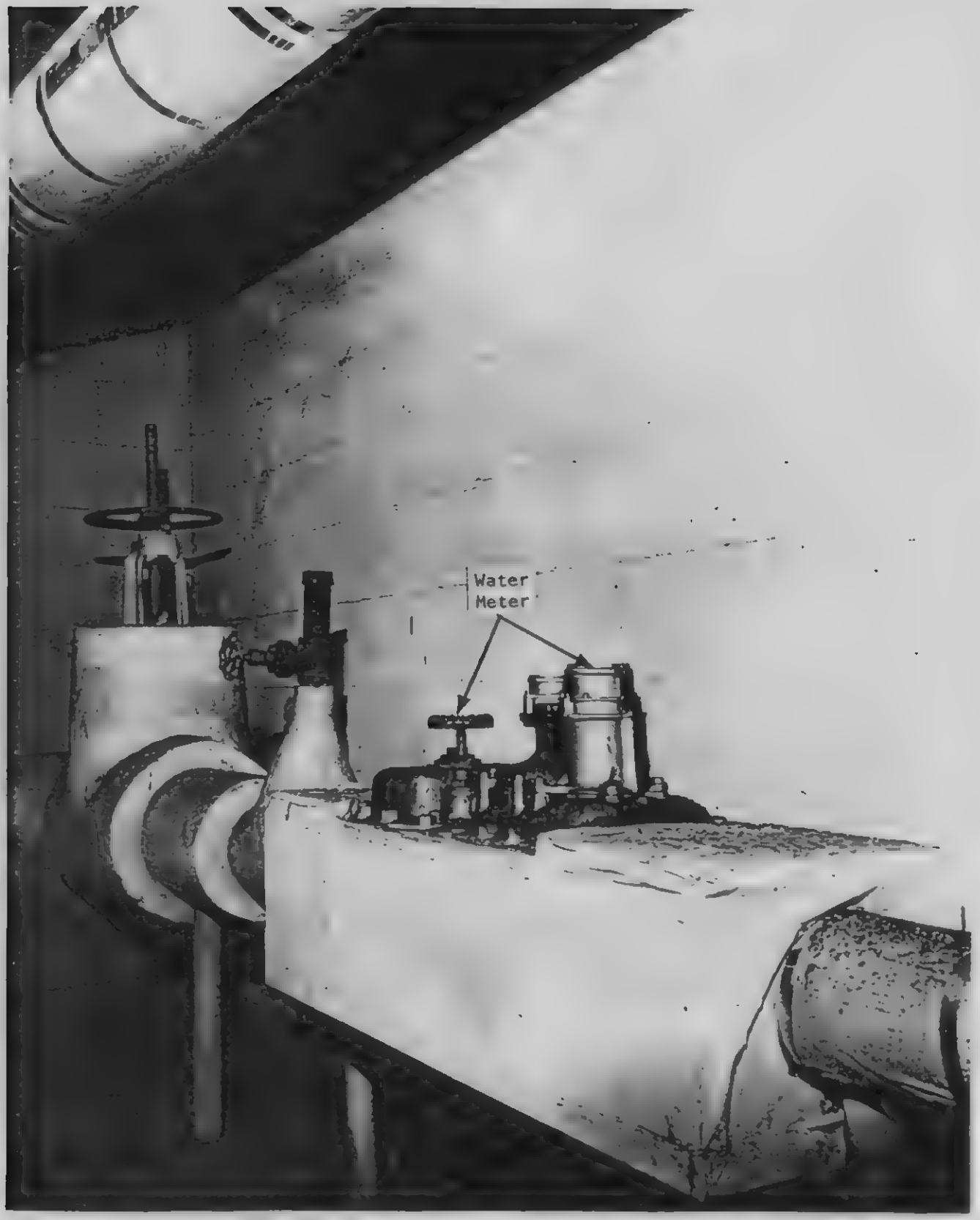
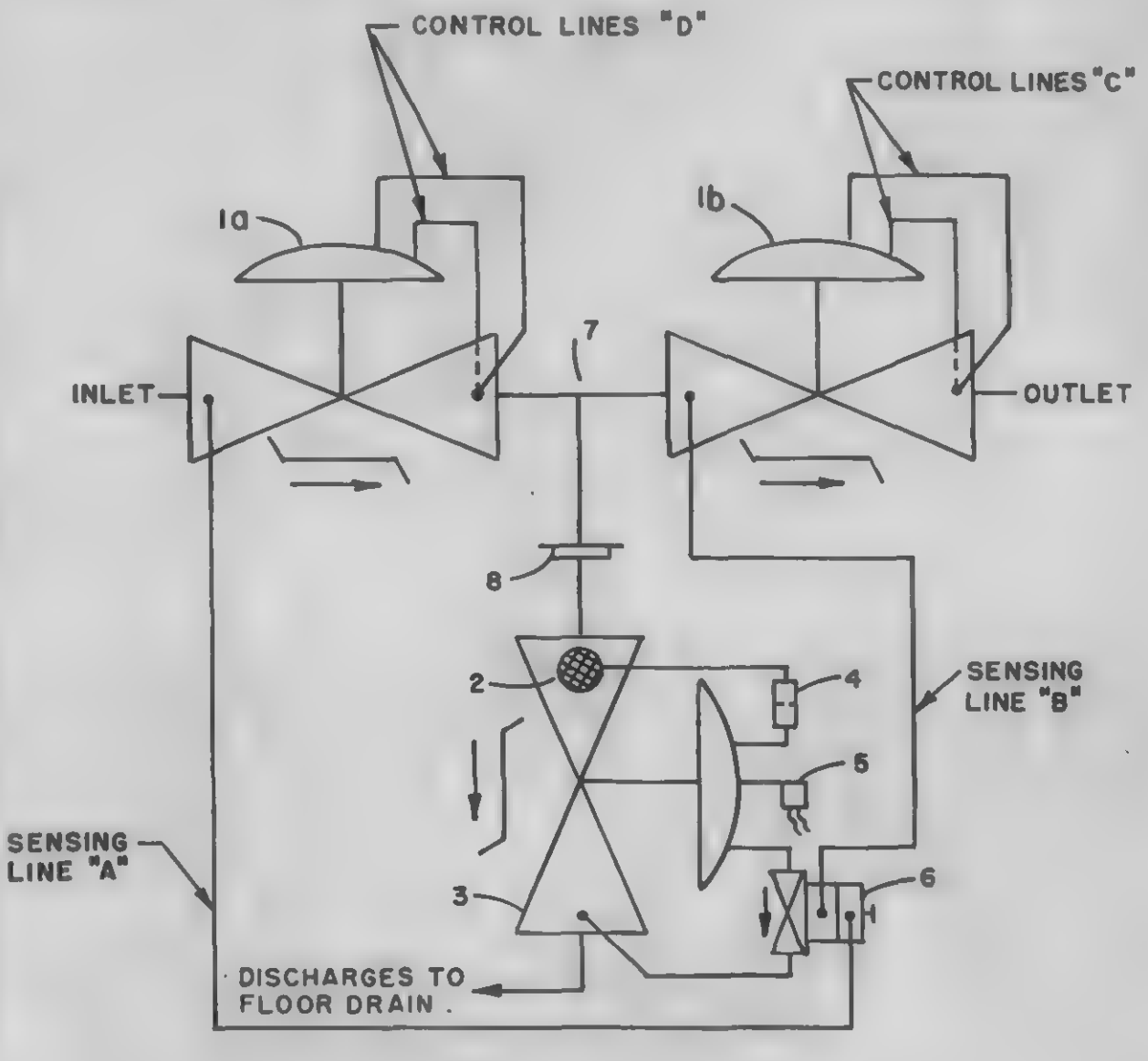


Figure 2.3 Water Meter

Figure 2.4 Low Pressure Switch

Figure 2.5 Backflow Preventer



LEGEND

Item No.	*Description*
1a,1b	Check Valves
2	Flow Clean Strainer
3	Differential Pressure Relief Valve
4	Restriction Tube
5	Switch Assembly
6	Differential Control
7	Pipe Tee
8	Companion Flange

Figure 2-6 Schematic Diagram Backflow Preventer

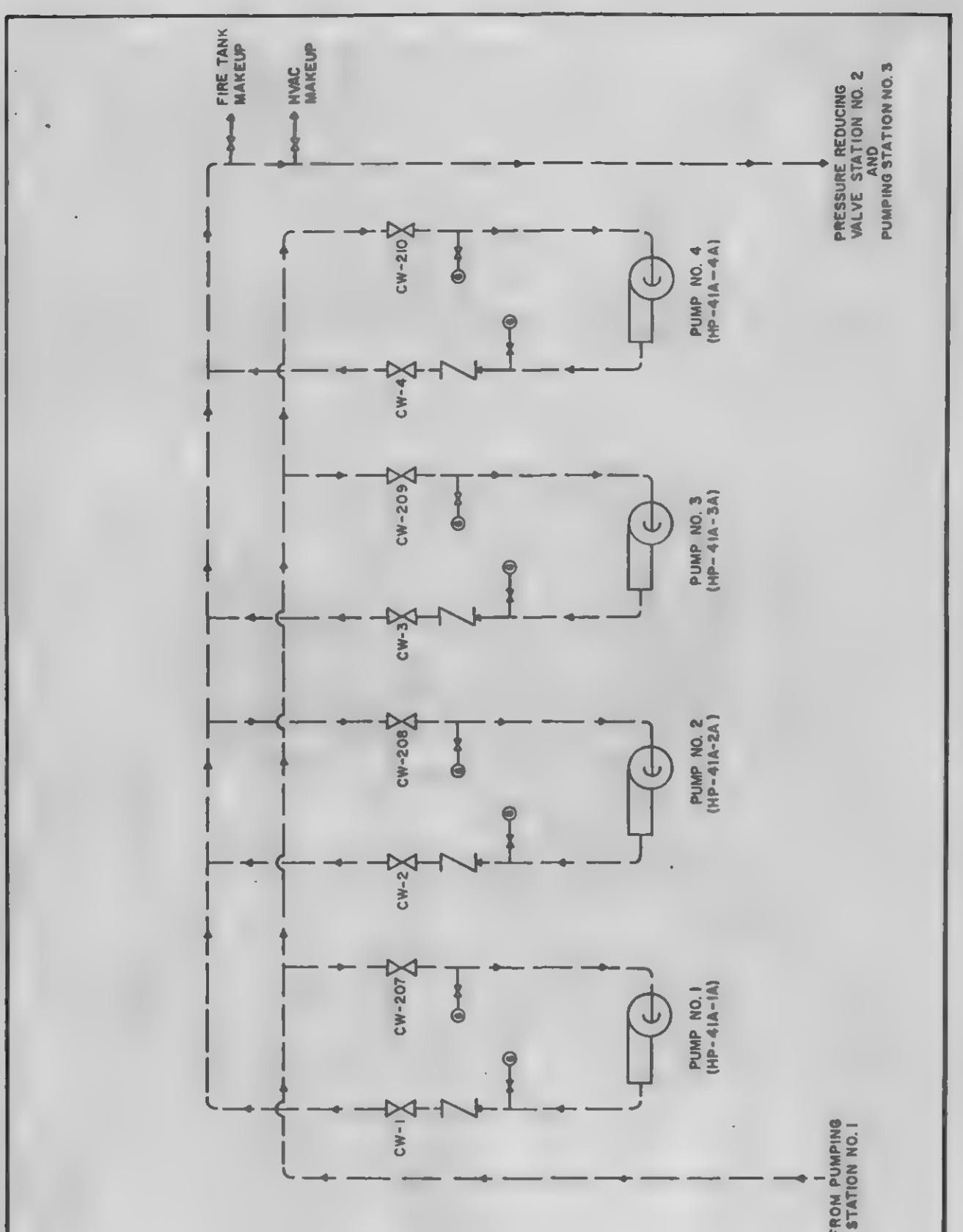


Figure 2-7 Schematic Diagram
Pumping Arrangement – MER – Floor 41 – Tower A

Figure 2.8 Pumping Arrangement
View 1

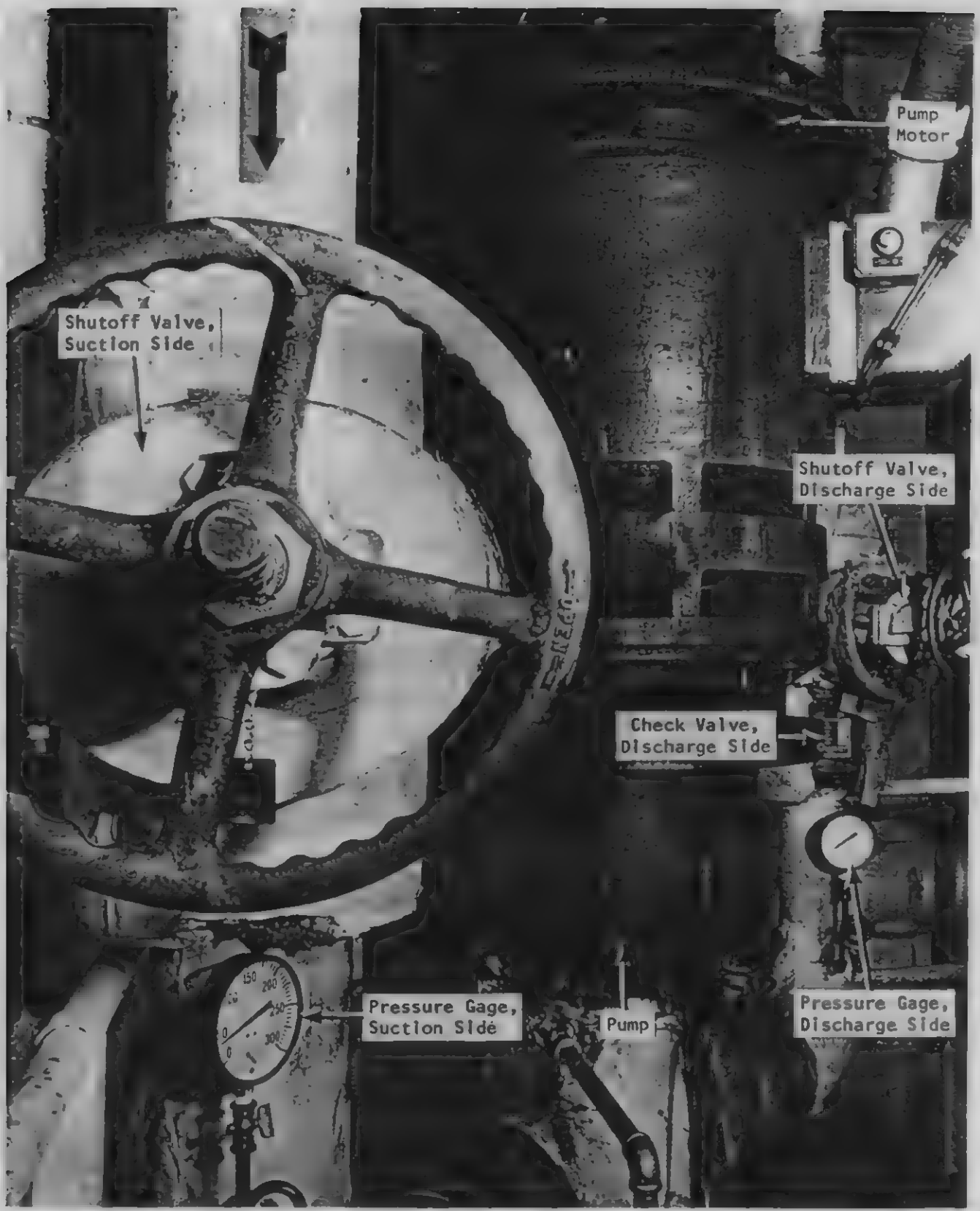


Figure 2.9A Individual Pump Arrangement
View 1

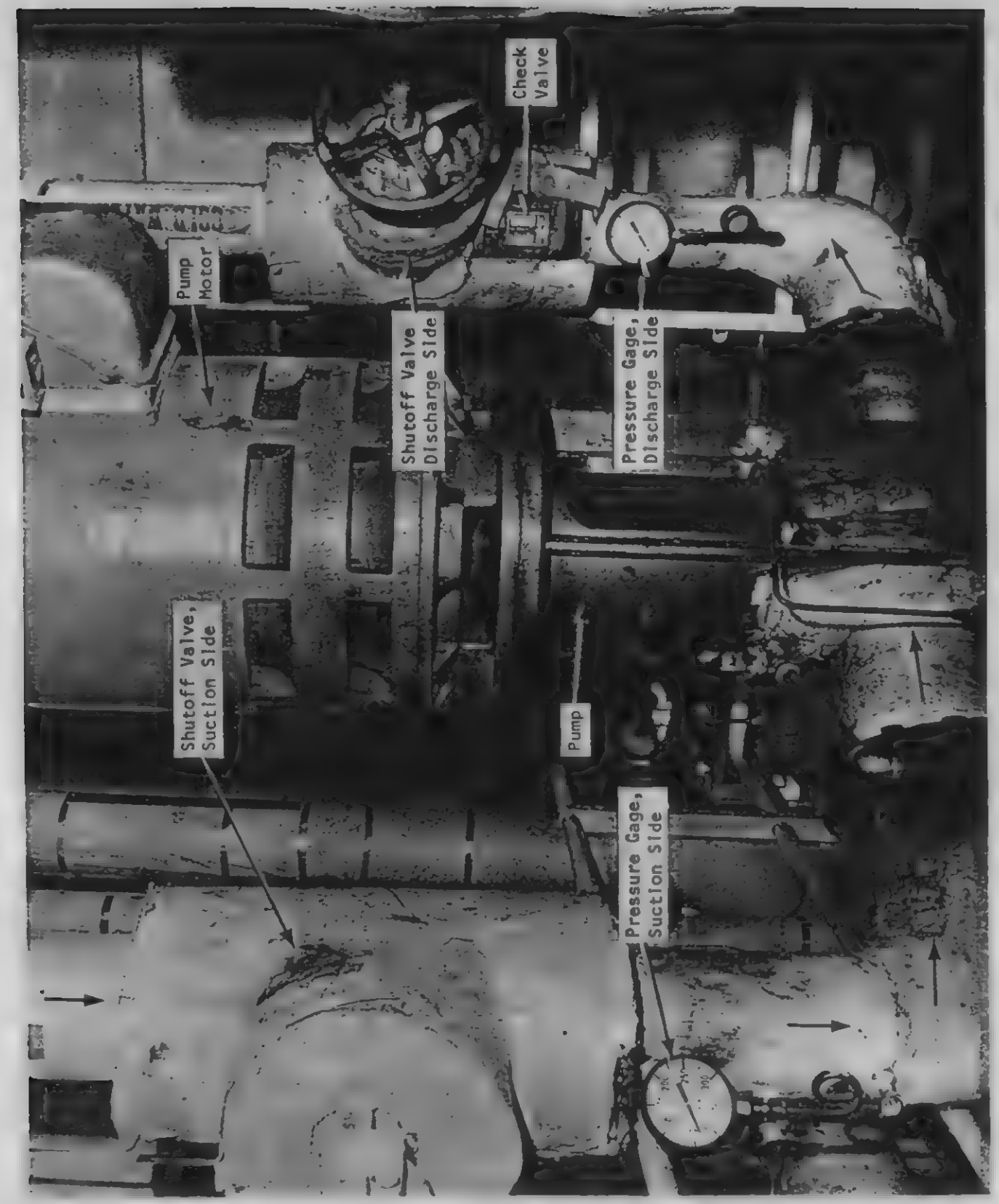


Figure 2.9B Pumping Arrangement
View 2

Parameter	*Pump No.1*	*Pump No.2*	*Pump No.3*	*Pump No.4*
Stages ...	13	10	10	10
Size	6MC	7MC	7MC	7MC
Figure ...	6937	6977	6977	6977
Frame				
Model				
Total Head		676 Ft.	676 Ft.	676 Ft.
Serial ...	K2N2051356	K2N2051357	K2N2051357 -1	K2N2051357 -2
RPM	3500	3500	3500	3500
GPM		530	530	530
Impeller Diameter..	15/32	A-23/32	A-23/32	A-23/32

Manufacturer .... Colt Industries
Fairbanks Morse Pump & Electric
Division, Kansas City, Kansas

Type ..... Fairbanks Morse Pumps

Figure 2.10A Nameplate Data - Pumps - Tower A
Pumping Station No. 1
Level B1 (294')

Parameter	*Pump No.1*	*Pump No.2*	*Pump No.3*	*Pump No.4*
Stages ...	9	8	8	8
Size	6MC	7MC	7MC	7MC
Figure ...	6977	6977	6977	6977
Frame				
Model				
Total Head	549 Ft.	549 Ft.	549 Ft.	549 Ft.
Serial....	K2N2051358	K2N2051359	K2N2051359-1	K2N2051359-2
RPM	3500	3500	3500	3500
GPM	239	477	477	477
Impeller Diameter..	A	B	B	B

Manufacturer .... Colt Industries
Fairbanks Morse Pump & Electric
Division, Kansas City, Kansas

Type ..... Fairbanks Morse Pumps

Figure 2.10B Nameplate Data - Pumps - Tower A
Pumping Station No. 2
MER, Floor 41

Parameter	*Pump No.1*	*Pump No.2*	*Pump No.3*	*Pump No.4*
Stages ...	9	7	7	7
Size	6MC	7MC	7MC	7MC
Figure ...	6977	6977	6977	6977
Frame				
Model				
Total Head	549 Ft.	530	530	530
Serial ...	K2N2051364	K2N2051361	K2N2051361-1	K2N2051361-2
RPM	3500	3500	3500	3500
GPM	239	424	424	424
Impeller Diameter..	A	B	B	B

Manufacturer .... Colt Industries
Fairbanks Morse Pump & Electric
Division, Kansas City, Kansas

Type ..... Fairbanks Morse Pumps

Figure 2.10C Nameplate Data - Pumps - Tower A
Pumping Station No. 3
MER, Floor 75

Parameter	*Pump No.1*	*Pump No.2*	*Pump No.3*	*Pump No.4*
Stages ...	13	10	10	10
Size	6MC	7MC	7MC	7MC
Figure ...	6977	6977	6977	6977
Frame				
Model				
Total Head	675 Ft.	676 Ft.	676 Ft.	676 Ft.
Serial ...	K2N2051362	K2N2051363 -2	K2N2051363	K2N2051363 -1
RPM	3500	3500	3500	3500
GPM	292	530	530	530
Impeller Diameter..	A	A	A	A

Manufacturer .... Colt Industries
Fairbanks Morse Pump & Electric
Division, Kansas City, Kansas

Type ..... Fairbanks Morse Pumps

Figure 2.10D Nameplate Data - Pumps - Tower B
Pumping Station No. 1
Level B1 (294')

Parameter	*Pump No.1*	*Pump No.2*	*Pump No.3*	*Pump No.4*
Stages ...	8	8	8	8
Size	6MC	7MC	7MC	7MC
Figure ...	6977	6977	6977	6977
Frame				
Model				
Total Head	530 Ft.	549 Ft.	549 Ft.	549 Ft.
Serial....	K2N2051360	K2N2051365	K2N2051365 -1	K2N2051365 -2
RPM	3500	3500	3500	3500
GPM	212	477	477	477
Impeller Diameter..	A	B	B	B

Manufacturer .... Colt Industries
Fairbanks Morse Pump & Electric
Division, Kansas City, Kansas

Type ..... Fairbanks Morse Pumps

Figure 2.10E Nameplate Data - Pumps - Tower B
Pumping Station No. 2
MER, Floor 41

Parameter	*Pump No.1*	*Pump No.2*	*Pump No.3*	*Pump No.4*
Stages ...	8	7	7	7
Size	6MC	7MC	7MC	7MC
Figure ...	6977	6977	6977	6977
Frame				
Model				
Total Head	530 Ft.	530 Ft.	530 Ft.	530 Ft.
Serial ...	K2N2051366	K2N2051367	K2N2051367	K2N2051367
RPM	3500	3500	3500	3500
GPM		424	424	424
Impeller Diameter..	A	B	B	B

Manufacturer .... Colt Industries
Fairbanks Morse Pump & Electric
Division, Kansas City, Kansas

Type ..... Fairbanks Morse Pumps

Figure 2.10F Nameplate Data - Pumps - Tower B
Pumping Station No. 3
MER, Floor 75

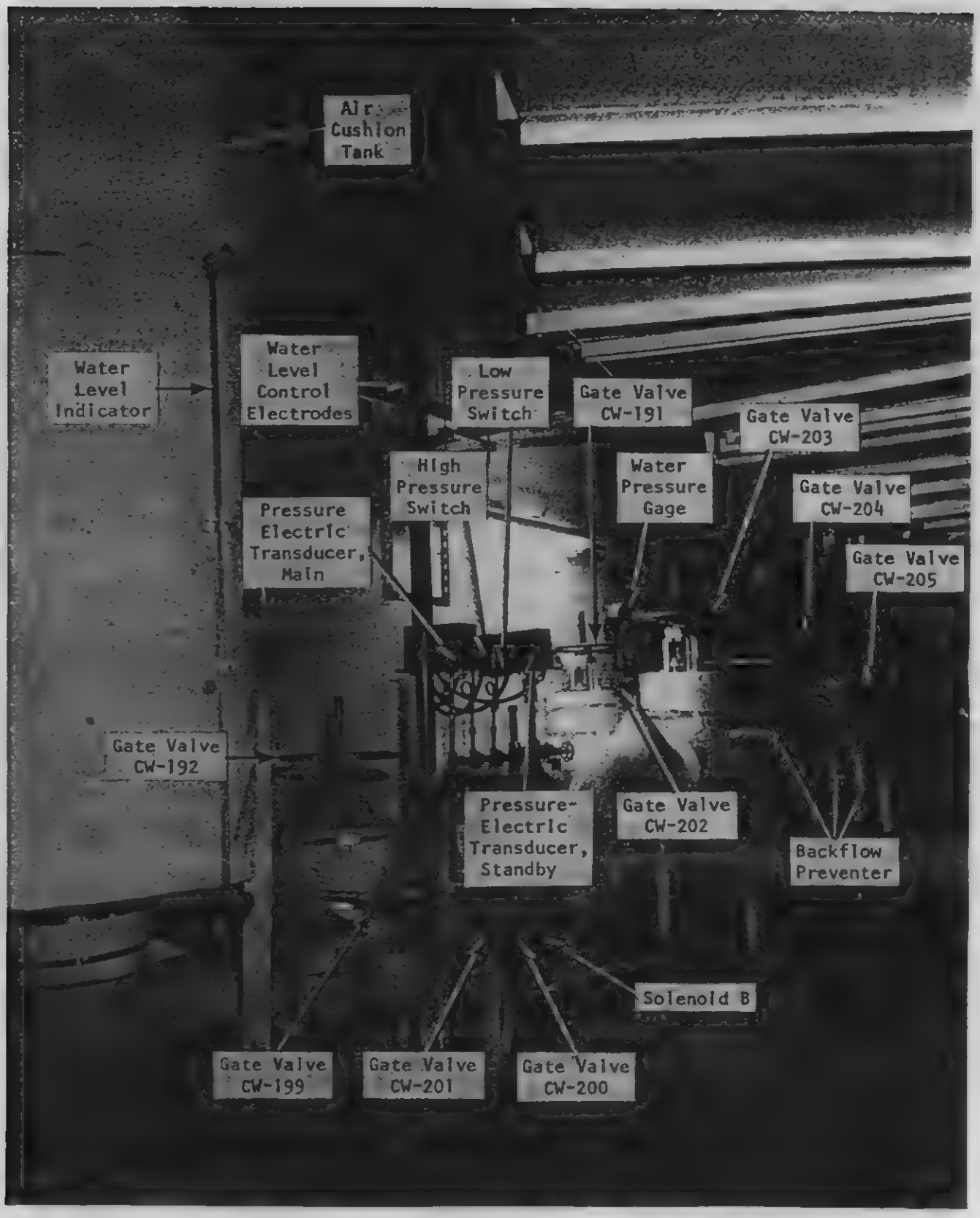


Figure 2.12 Mechanical Controls

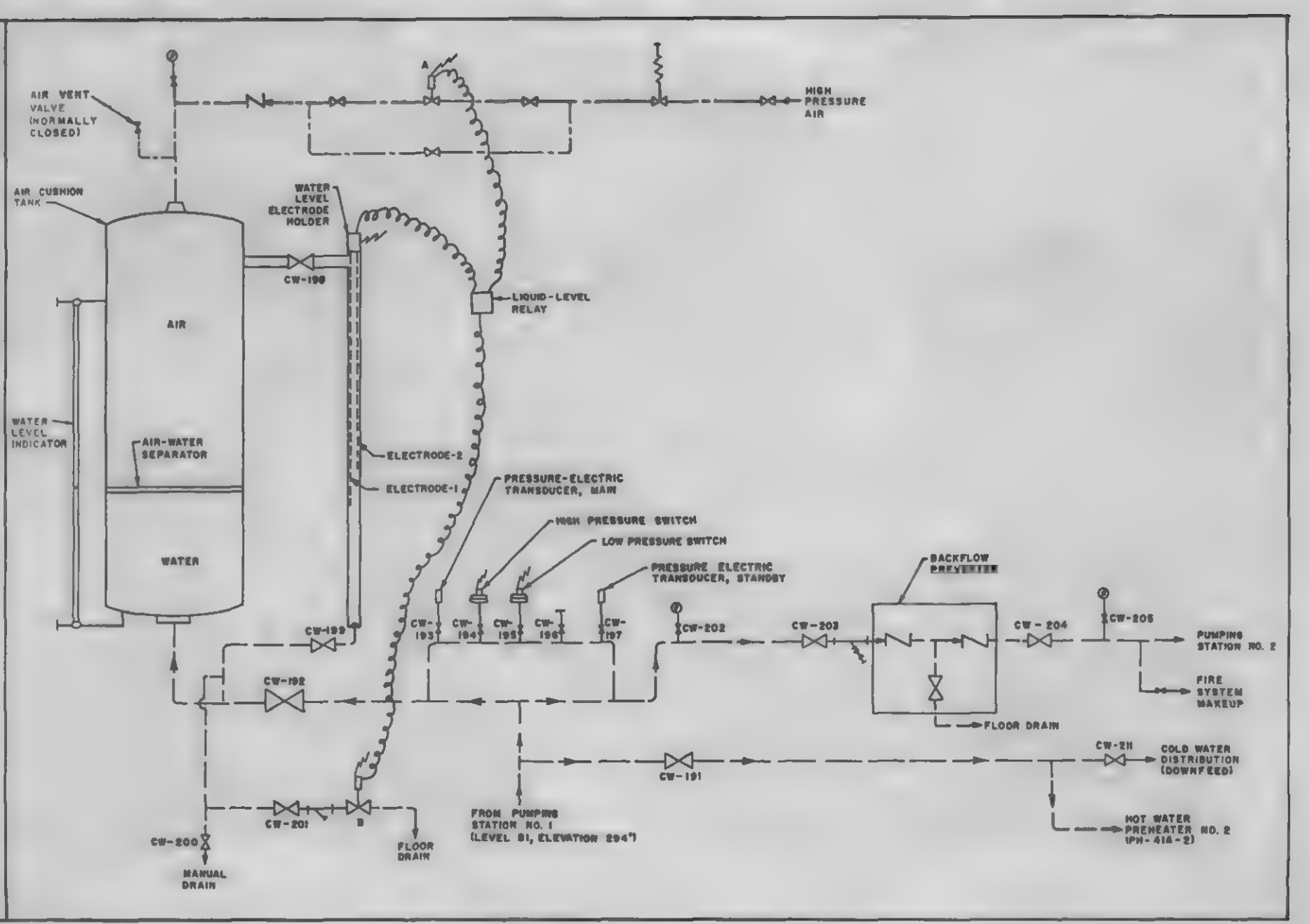


Figure 2-11 Schematic Diagram
Mechanical Controls — MER — Floor 41 — Tower A

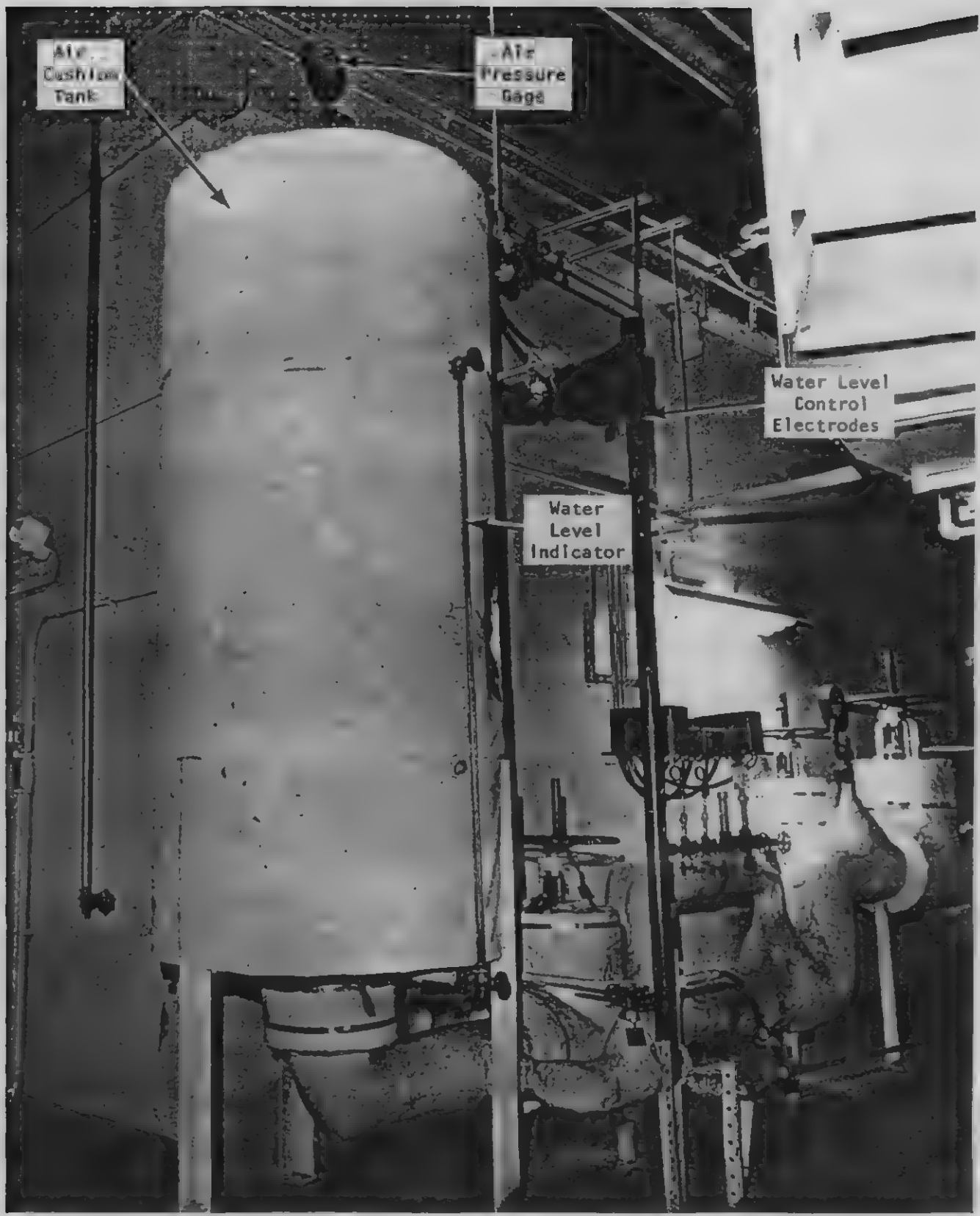


Figure 2.13 Air Cushion Tank
View 1

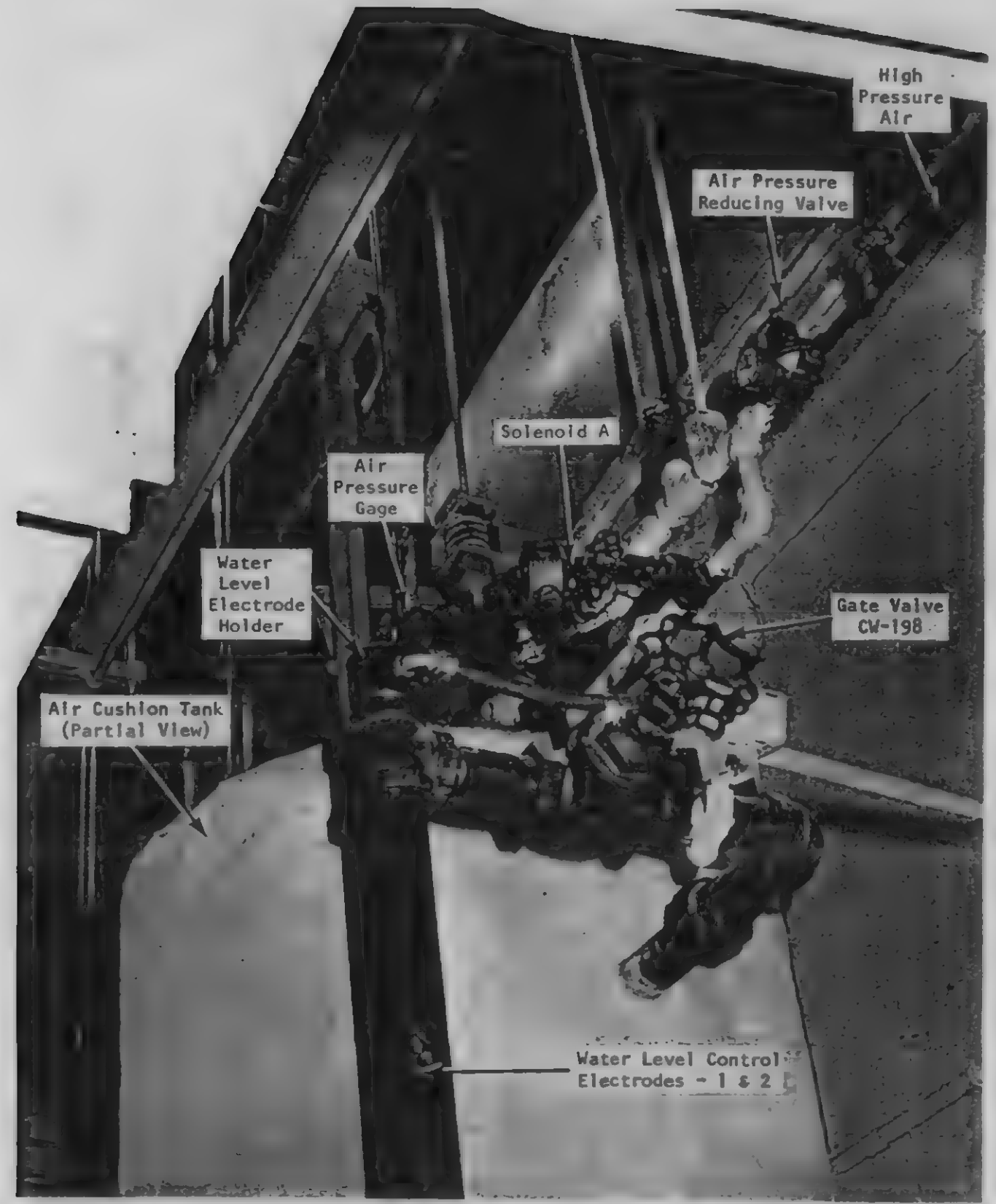


Figure 2.14 Air Cushion Tank
View 2

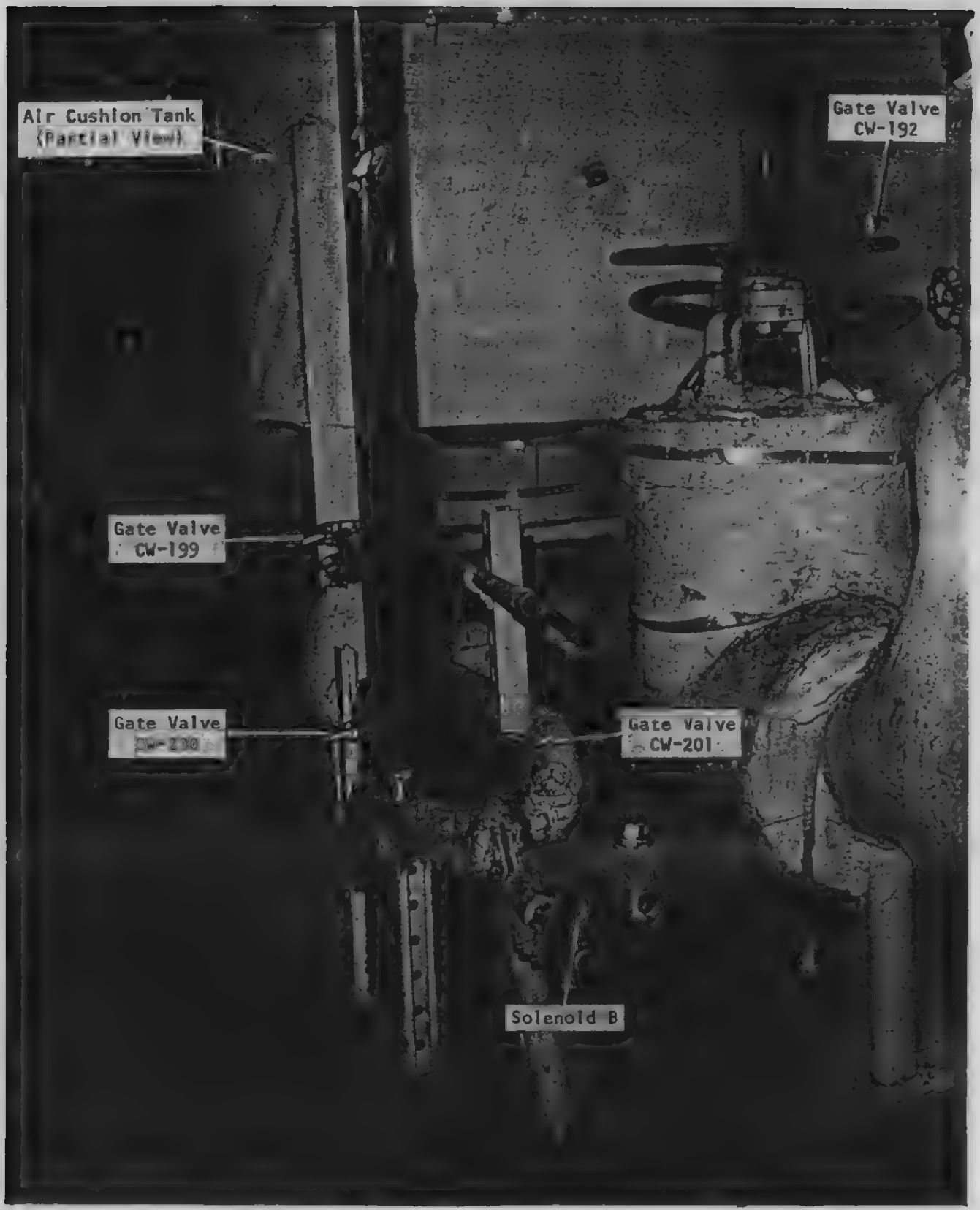


Figure 2.15 Air Cushion Tank
View 3

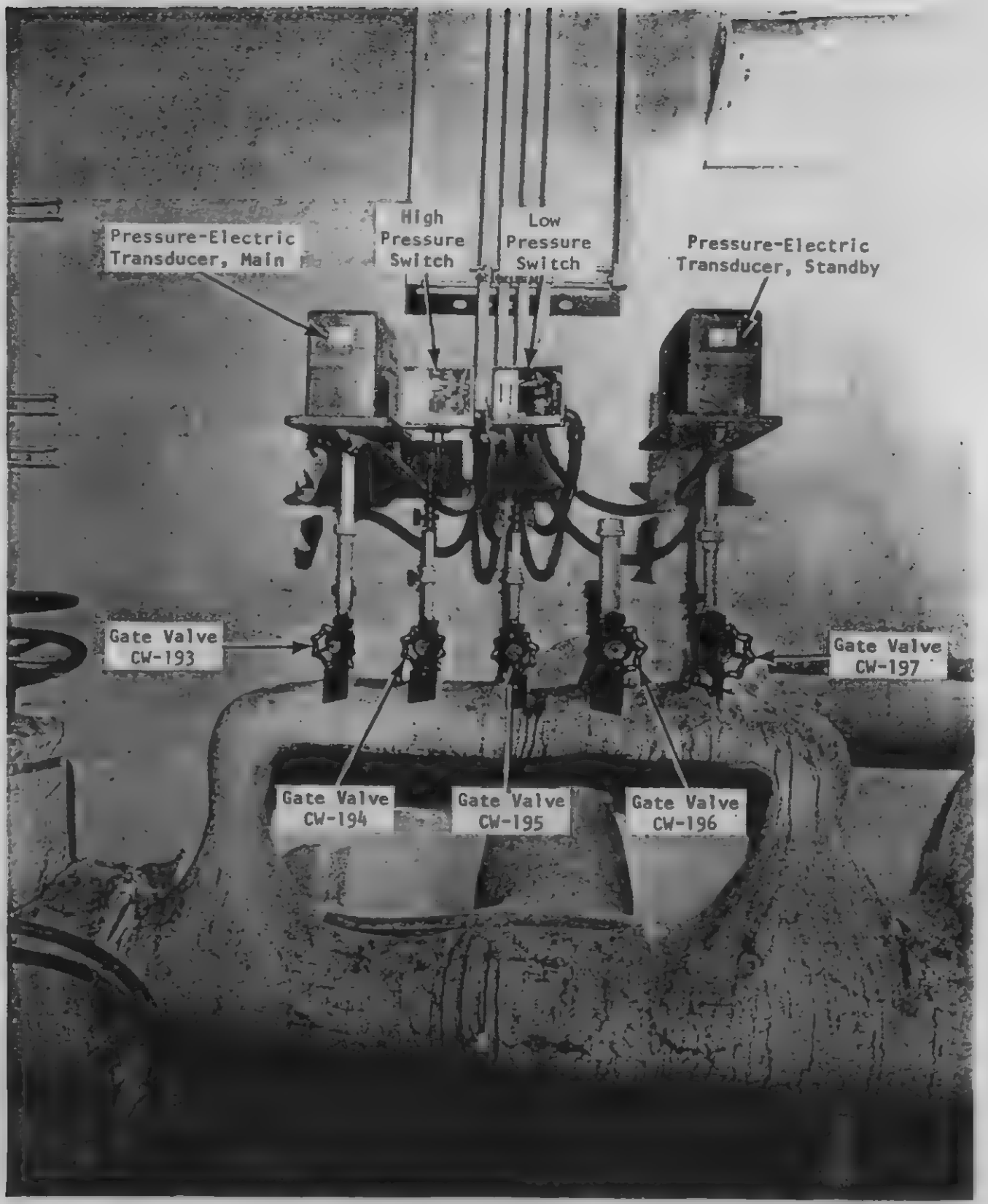


Figure 2.16 Pressure Switches and Transducers

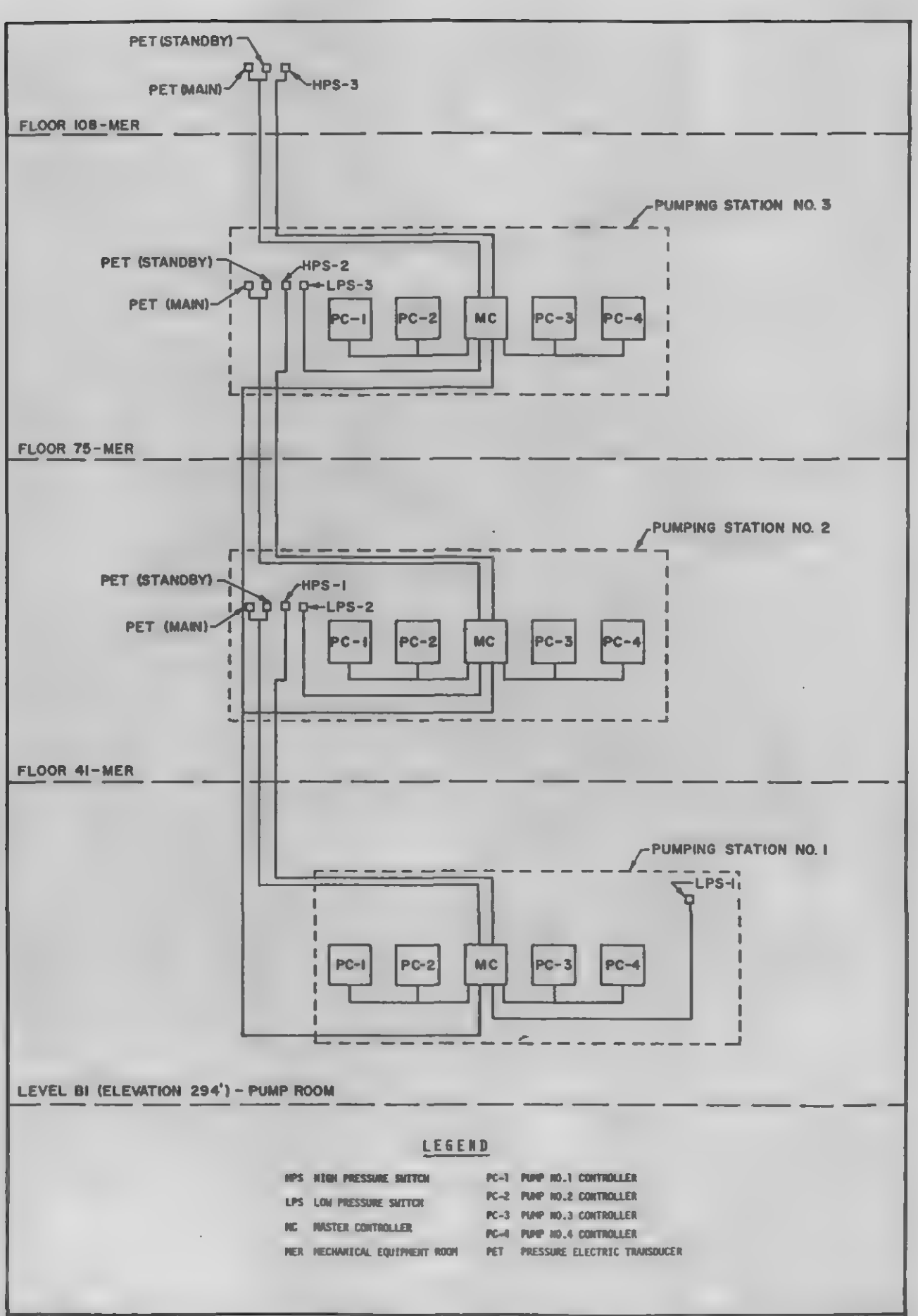


Figure 2-17A Interconnection Diagram
Master and Individual Pump Controllers

Figure 2.17B Master Controller and Pump Controllers
Pumping Station No. 2

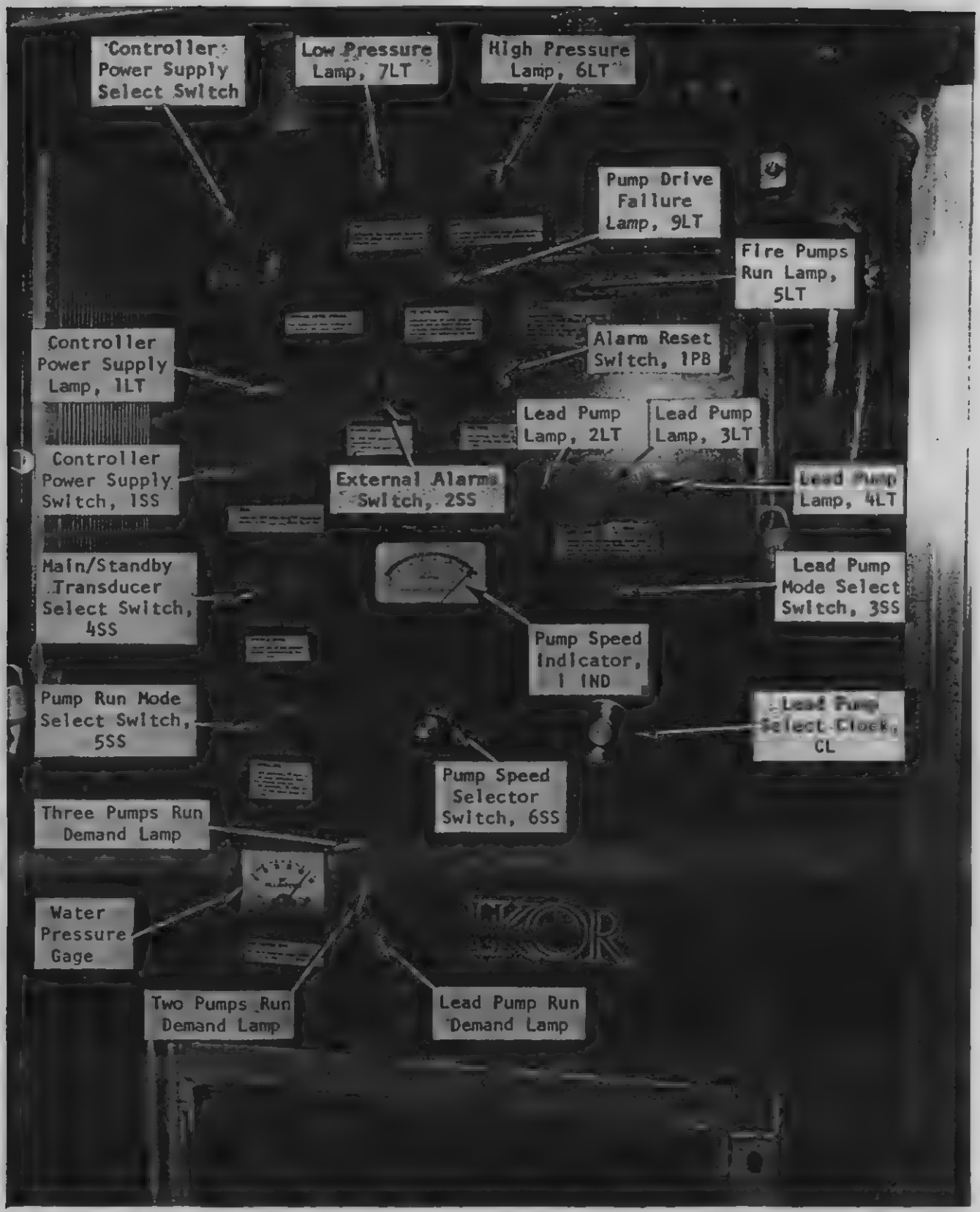


Figure 2.18 Control Panel - Front View
Master Controller

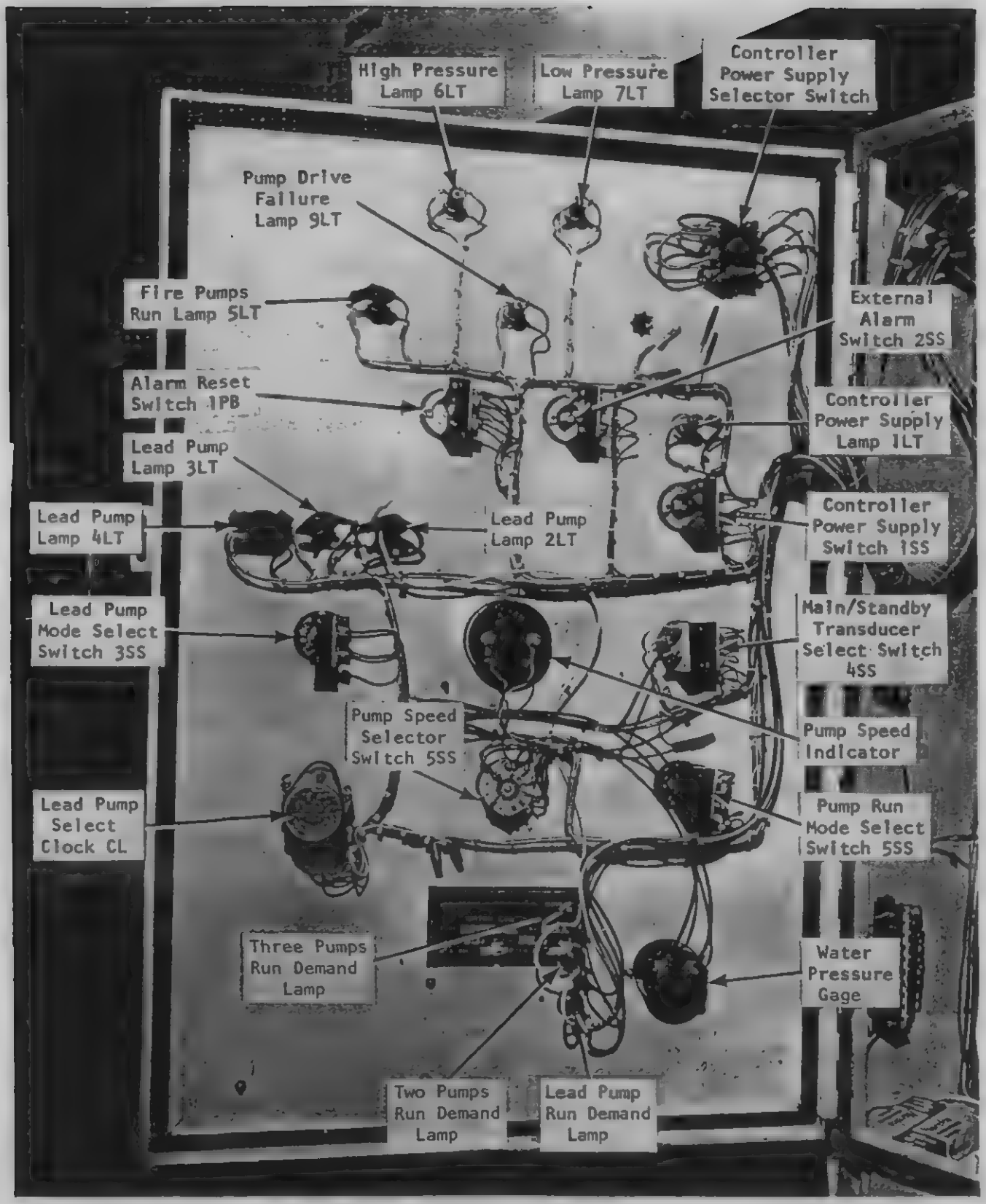


Figure 2.19 Control Panel - Rear View
Master Controller

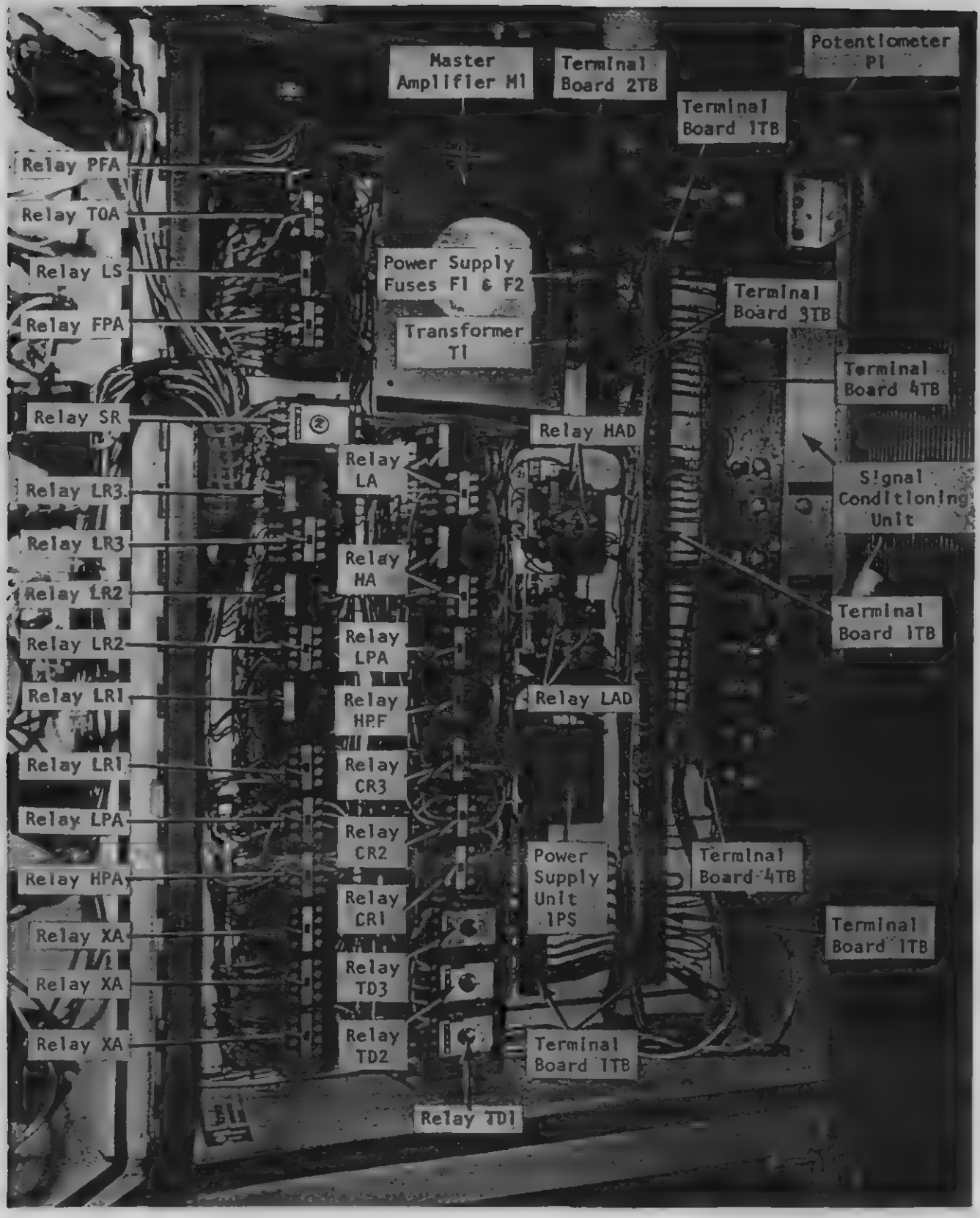


Figure 2.20 Master Controller
Interior View

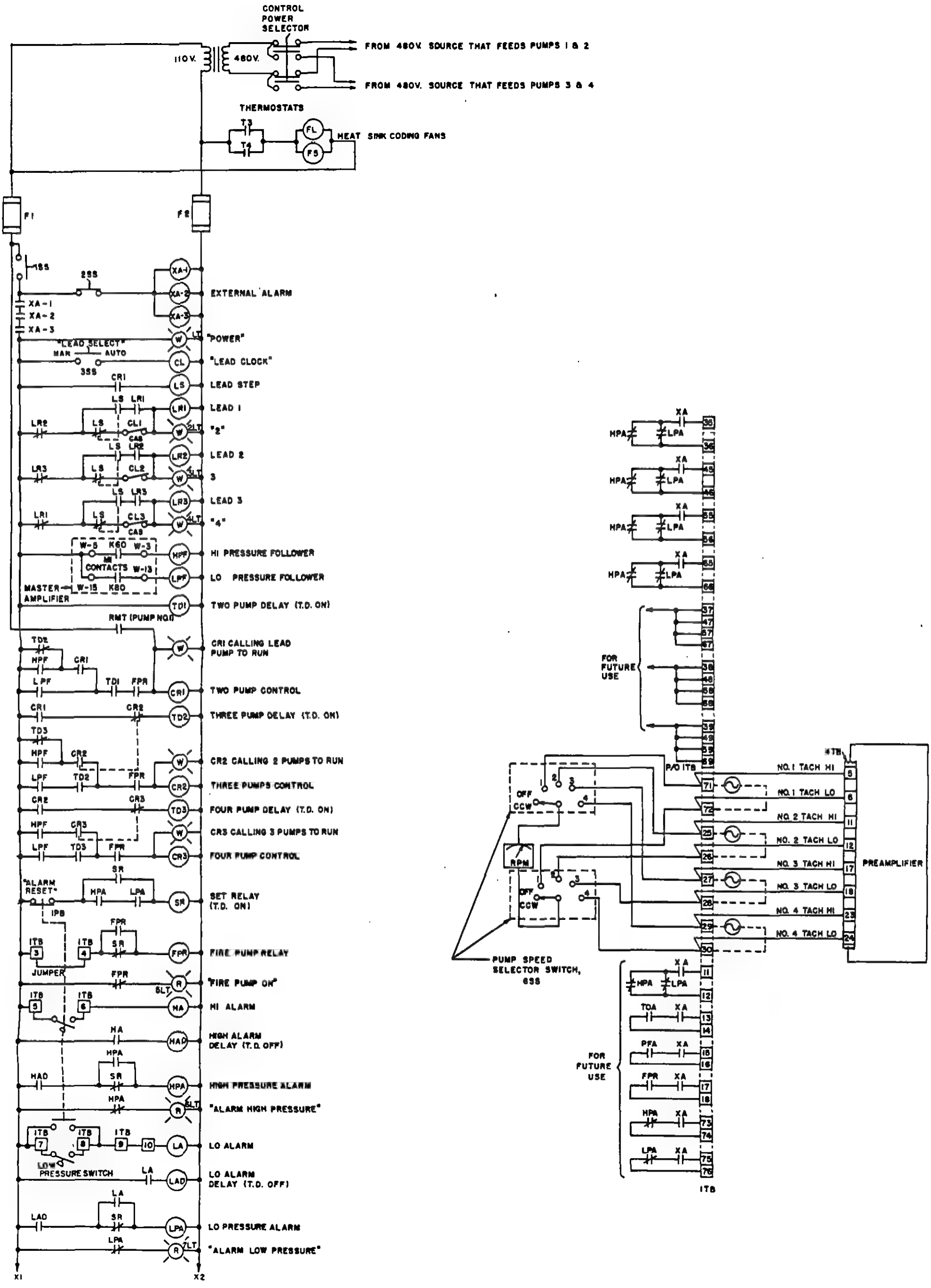


Figure 2-21b Schematic Diagram Master Controller

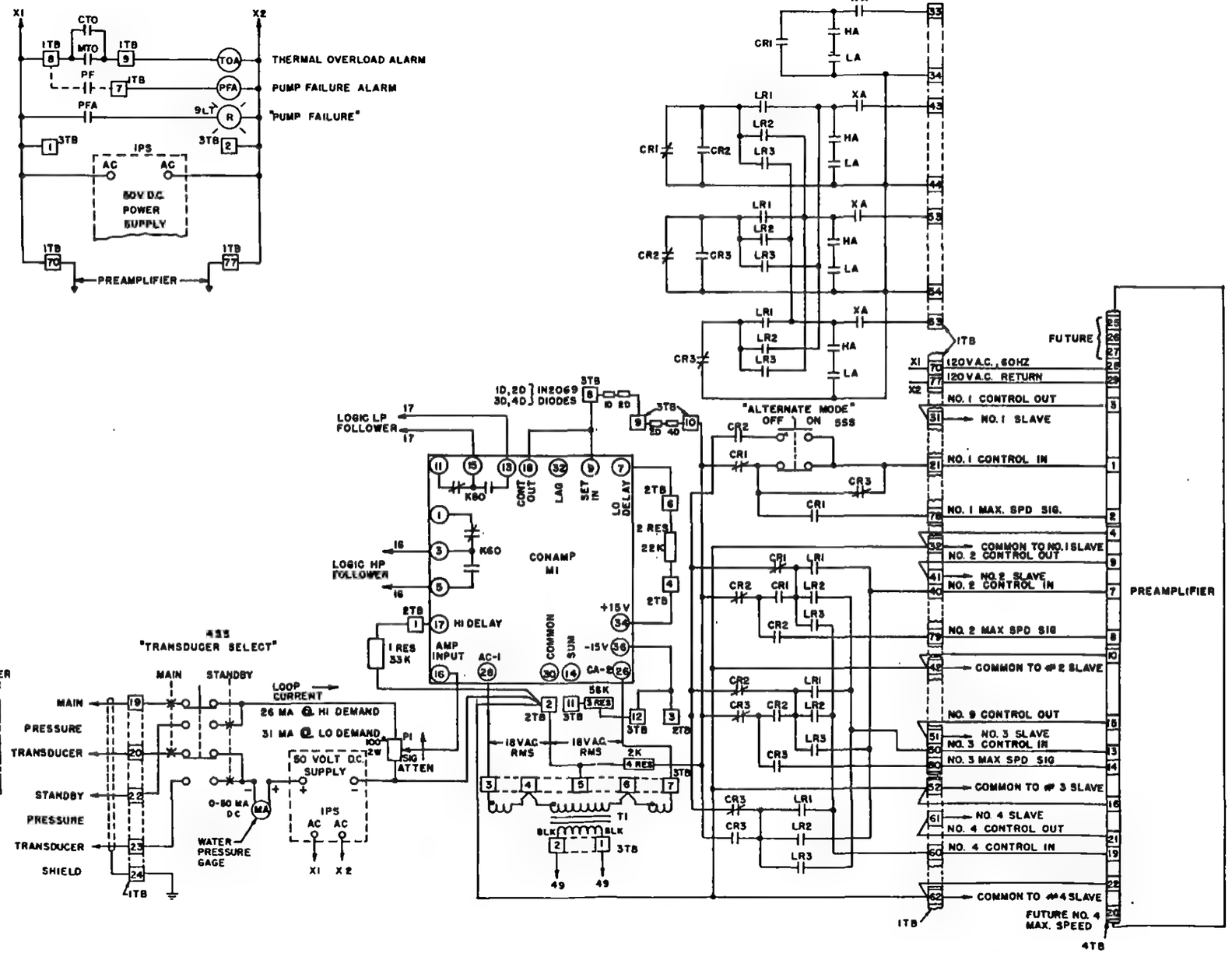


Figure 2-21a Schematic Diagram
Master Controller

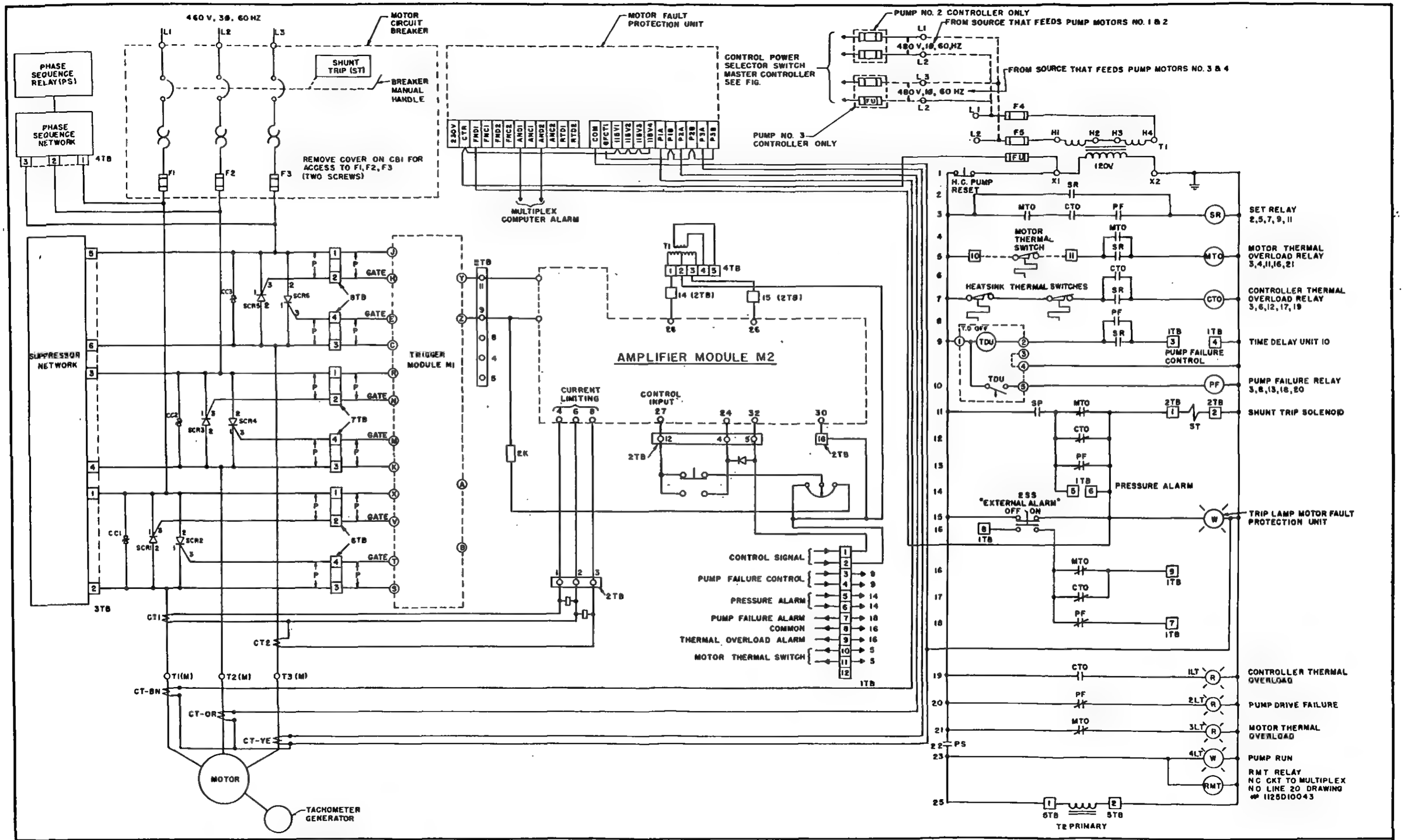


Figure 2-27 Schematic Diagram Individual Pump Controller

Symbol	Description
1D, 2D, 3D, 4D	Rectifier Diodes
1IND	Pump Speed Indicator
1LT	Power Supply ON Lamp
2LT	Pump No.2 Lead Lamp
3LT	Pump No.3 Lead Lamp
4LT	Pump No.4 Lead Lamp
5LT	Fire Pumps Run Lamp
6LT	High Pressure Alarm Lamp
7LT	Low Pressure Alarm Lamp
8LT	Thermal Overload Alarm Lamp
9LT	Pump Failure Alarm Lamp
1PS	Power Supply, 50V DC
1R	Resistor (33K); provides time delay before turning off a pump
2R	Resistor (22K); provides time delay before cutting in a pump
3R	Resistor (56K)
4R	Resistor (2K)
1SS	Power Supply Switch
2SS	External Alarms Switch
3SS	Lead Pump Mode Select Switch
4SS	Main/Standby Transducer Select Switch
5SS	Pump Run Mode Select Switch
6SS	Pump Speed Select Switch
1TB	Terminal Board; provides connection to pump controllers and transducers
2TB	Terminal Board; provides connection points for 1R, 2R, 3R, and 4R

Figure 2-22A Legend
Master Controller

Symbol	Description
3TB	Terminal Board; provides connection points between Transformer T1 and Amplifier M1
4TB	Terminal Board; Preamplifier
CL	Lead Pump Selector Clock
CR1	Lead Pump Run Demand Relay
CR2	Two Pumps' Run Demand Relay
CR3	Three Pumps' Run Demand Relay
CTO	Controller (Pump) Thermal Overload Relay Contact
F1,F2	Power Supply Fuses
FPR	Fire Pump Relay
HA	High Pressure Signal Relay
HAD	High Pressure Signal Delay Relay
HPA	High Pressure Alarm Relay
HPF	High Pressure Follower Relay
LA	Low Pressure Signal Relay
LAD	Low Pressure Signal Time Delay Relay
LPA	Low Pressure Alarm Relay
LPF	Low Pressure Follower Relay
LR1	Pump No. 2 Lead Relay
LR2	Pump No. 3 Lead Relay
LR3	Pump No. 4 Lead Relay
LS	Lead Pump Select Relay
MTO	Motor Thermal Overload Relay Contact
PI	Potentiometer, Amplifier Input
PF	Pump Failure Relay Contact
PFA	Pump Failure Alarm Relay

Figure 2-22B Legend
Master Controller

Symbol	Description
RMT	Remote Multiplex Terminal Relay Contact
SR	Set Relay
TI	Transformer; steps down 120V, 1Ø, 60 HZ to 36V, 1Ø, 60 HZ
TD1	Time Delay Relay; Two Pump Run Condition
TD2	Time Delay Relay; Three Pump Run Condition
TD3	Time Delay Relay; Four Pump Run Condition
TOA	Thermal Overload Relay
XA-1 XA-2 XA-3	External Alarm Relays

Figure 2-22C Legend
Master Controller

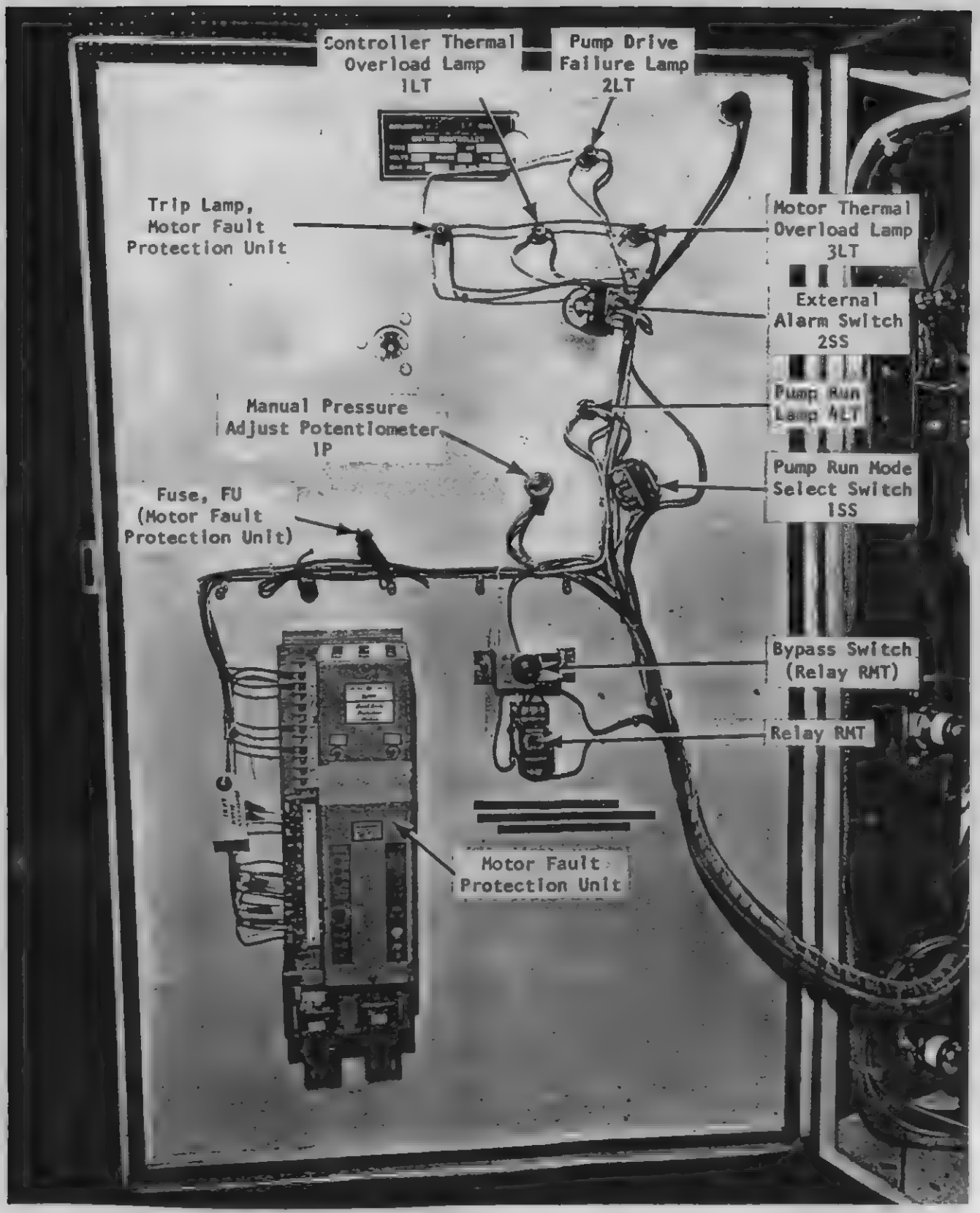


Figure 2.24 Control Panel - Rear View
Individual Pump Controller

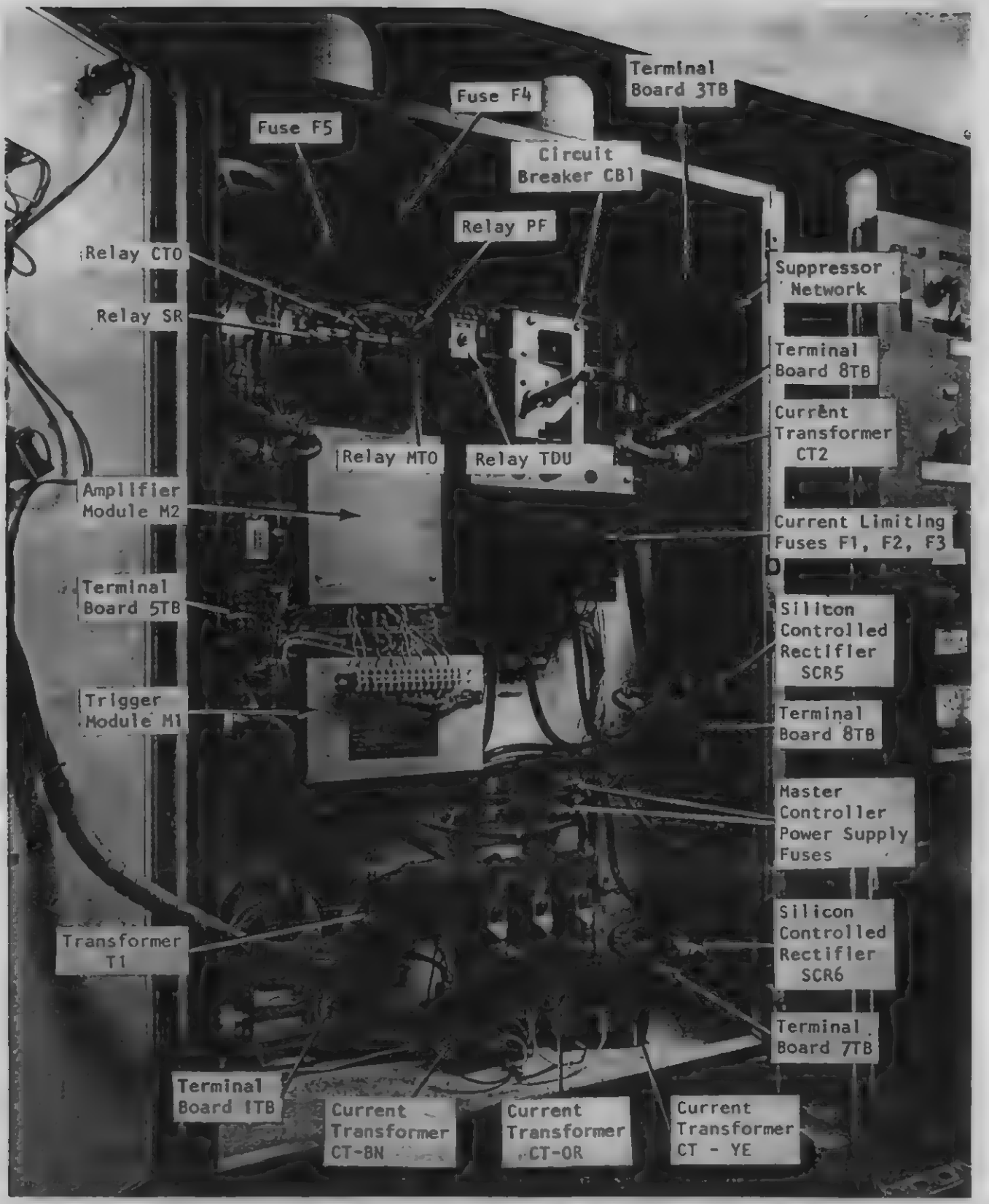


Figure 2.25 Individual Pump Controller
Interior View 1

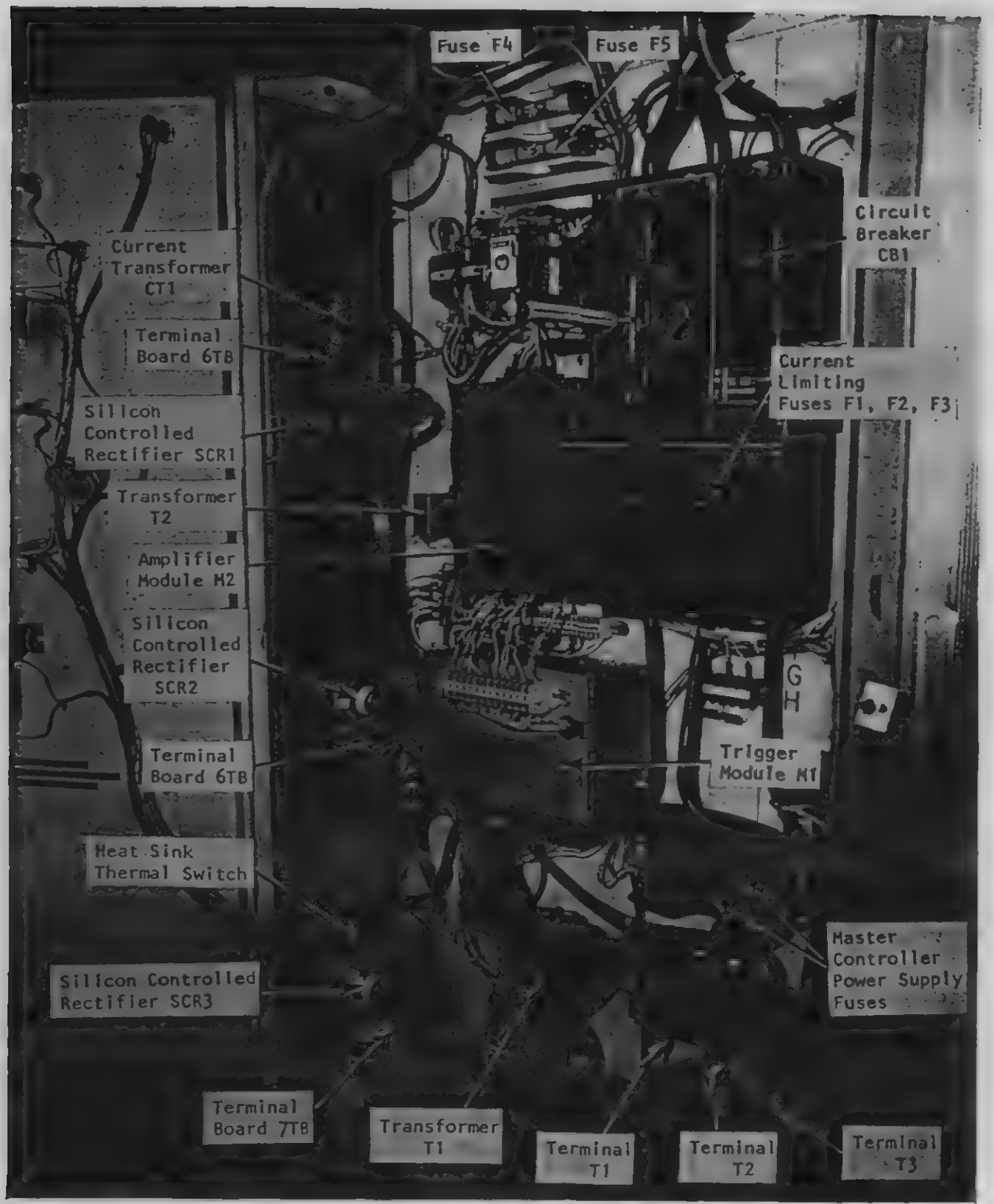


Figure 2.26 Individual Pump Controller Interior View 2

Symbol	Description
1LT	Controller Thermal Overload Lamp
2LT	Pump Drive Failure Lamp
3LT	Motor Thermal Overload Lamp
4LT	Pump Run Lamp
1P	Manual Pressure Adjust Potentiometer
1R	
1SS	Pump Run Mode Select Switch; Manual and Auto Positions
2SS	External Alarms Switch
1TB	Terminal Board
2TB	Terminal Board; Breaker Shunt Trip Coil
3TB	Terminal Board; Suppressor Network
4TB	Terminal Board; Suppressor Network
5TB	Terminal Board; Transformer T2
6TB	Terminal Board; Silicon Controlled Rectifiers SCR1 and SCR2
7TB	Terminal Board; Silicon Controlled Rectifiers SCR3 and SCR4
8TB	Terminal Board; Silicon Controlled Rectifiers SCR5 and SCR6
CB	Motor Circuit Breaker
CC1, CC2, CC3	Thyrectors
CT1, CT2	Current Transformers; Current Limiting
CT-BN, CT-OR, CT-YE	Current Transformers; Fault Protection Unit
CTO	Controller Thermal Overload Relay

Figure 2-28A Legend - Individual Pump Motor Controller

Symbol	Description
F1,F2,F3	Current Limiting Fuses
F4,F5	Fuses; Transformer T1
H1,H2, H3,H4	High Voltage Terminals, Transformer T1
HTS	Heatsink Thermal Switches
L1,L2,L3	Line Terminals
M1	Trigger Module
M2	Amplifier Module
MTO	Motor Thermal Overload Relay
PF	Pump Failure Relay
PS	Phase Sequence Relay
RMT	Remote Multiplex Terminal Relay
SCR1, SCR2, SCR3, SCR4, SCR5, SCR6	Silicon Controlled Rectifiers
SR	Set Relay
ST	Shunt Trip Coil; Motor Circuit Breaker
T1	Power Transformer; steps down 480V, 1Ø, 60 HZ to 120V, 1Ø, 60 HZ
T2	Control Transformer; steps down 120V, 1Ø, 60 HZ to 18V, 1Ø, 60 HZ
T1(M), T2(M), T3(M)	Motor Power Supply Terminals
TDU	Time Delay Relay; time delay opening on energization

Figure 2-28B Legend - Individual
Pump Motor Controller

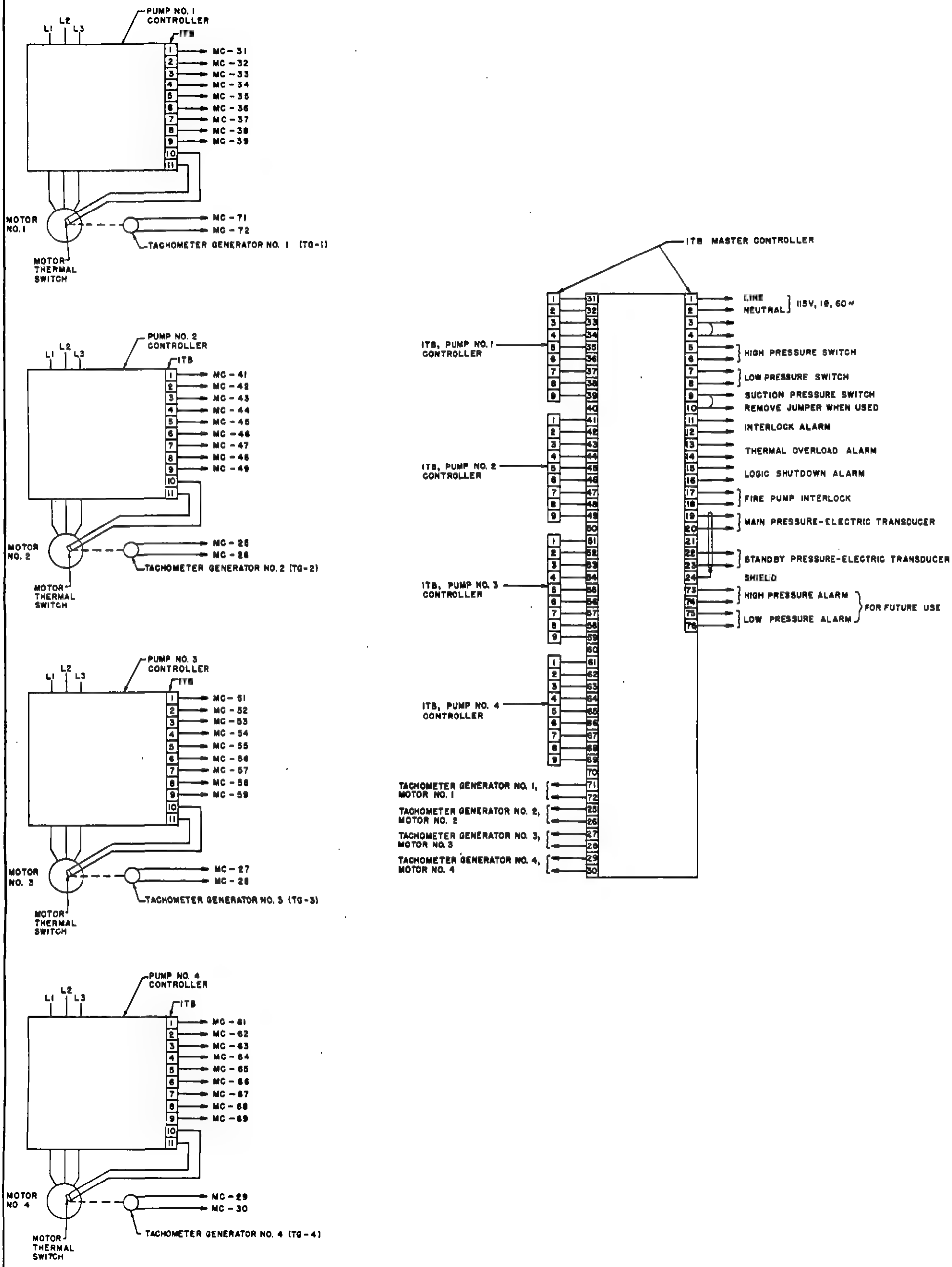


Figure 2-29 **Schematic Diagram Master and Individual Pump Controllers**

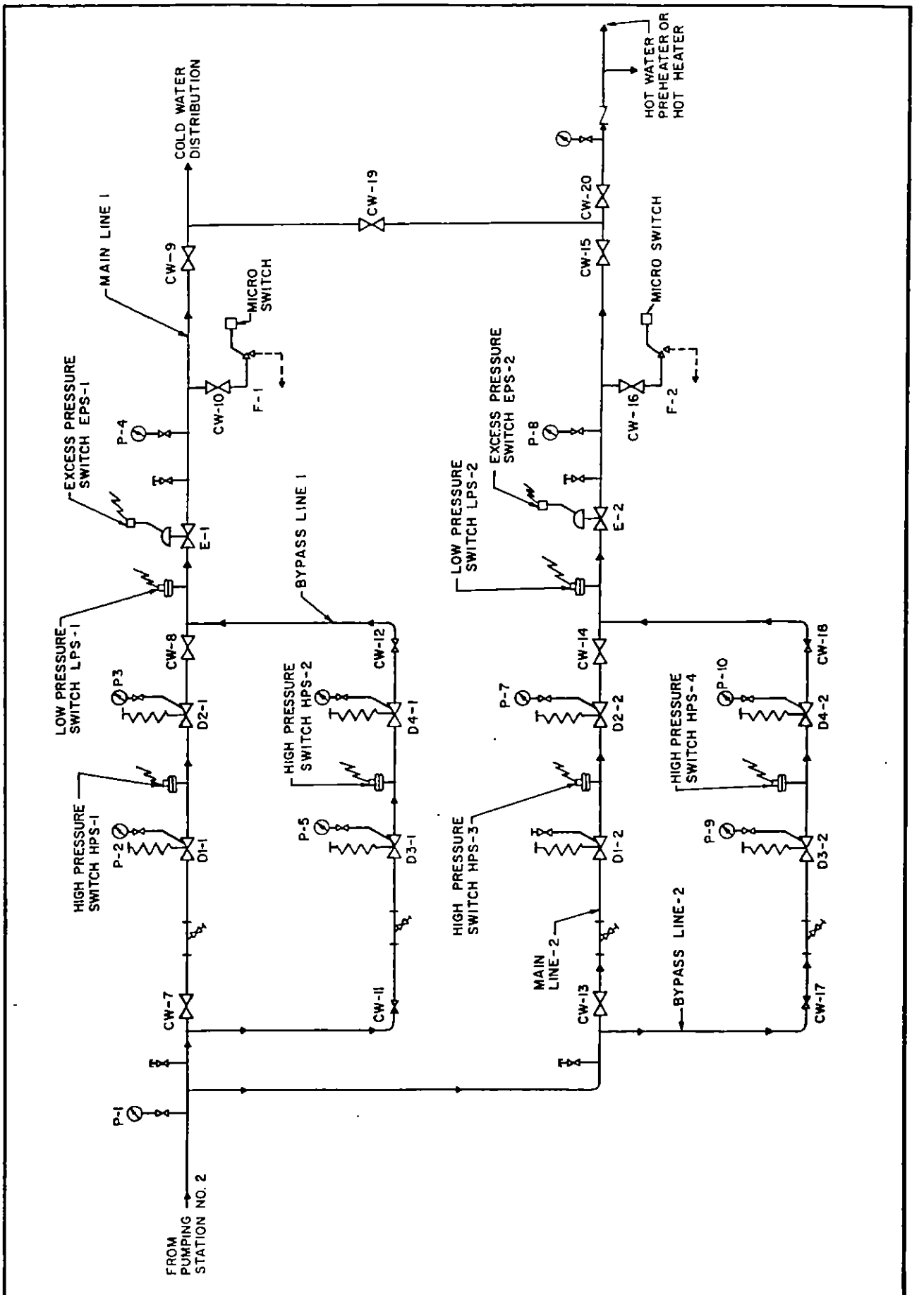


Figure 2-30 **Schematic – Pressure Reducing Valve Station**
MER – Floor 41 – Tower A

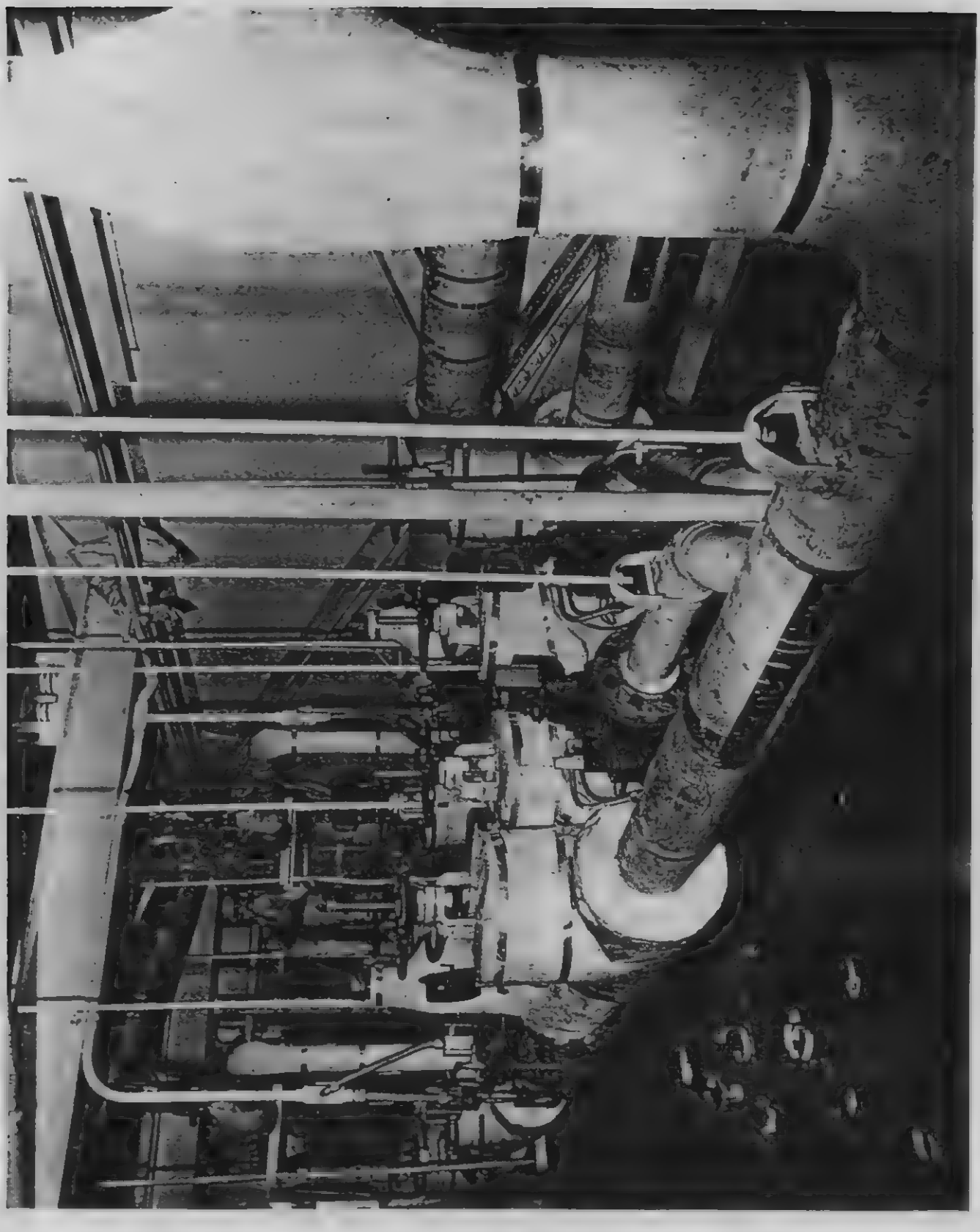


Figure 2.31 Pressure Reducing Valve Station
Overall View

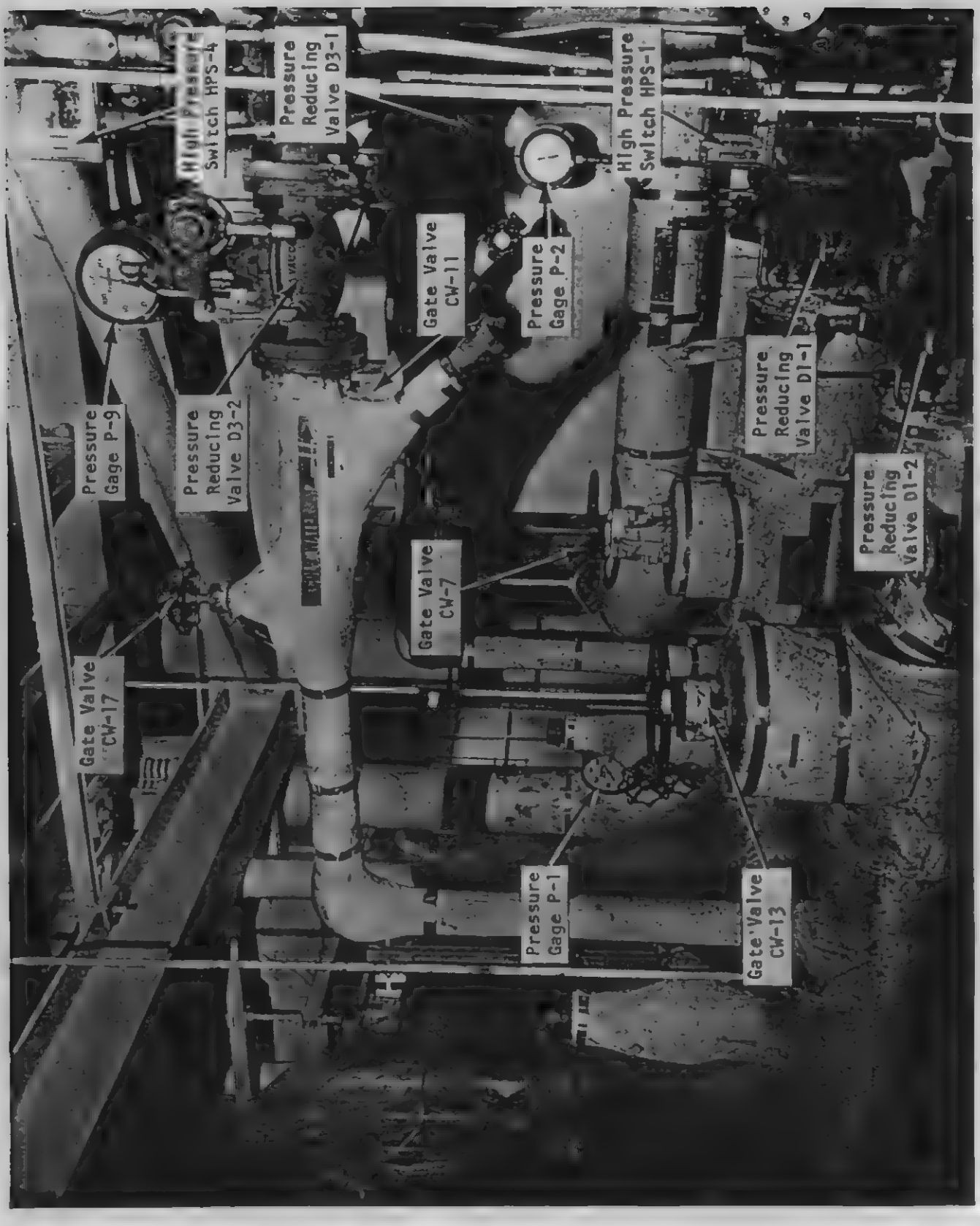


Figure 2.32 Pressure Reducing Valve Station
Partial View 1

Figure 2.33 Pressure Reducing Valve Station
Partial View 2

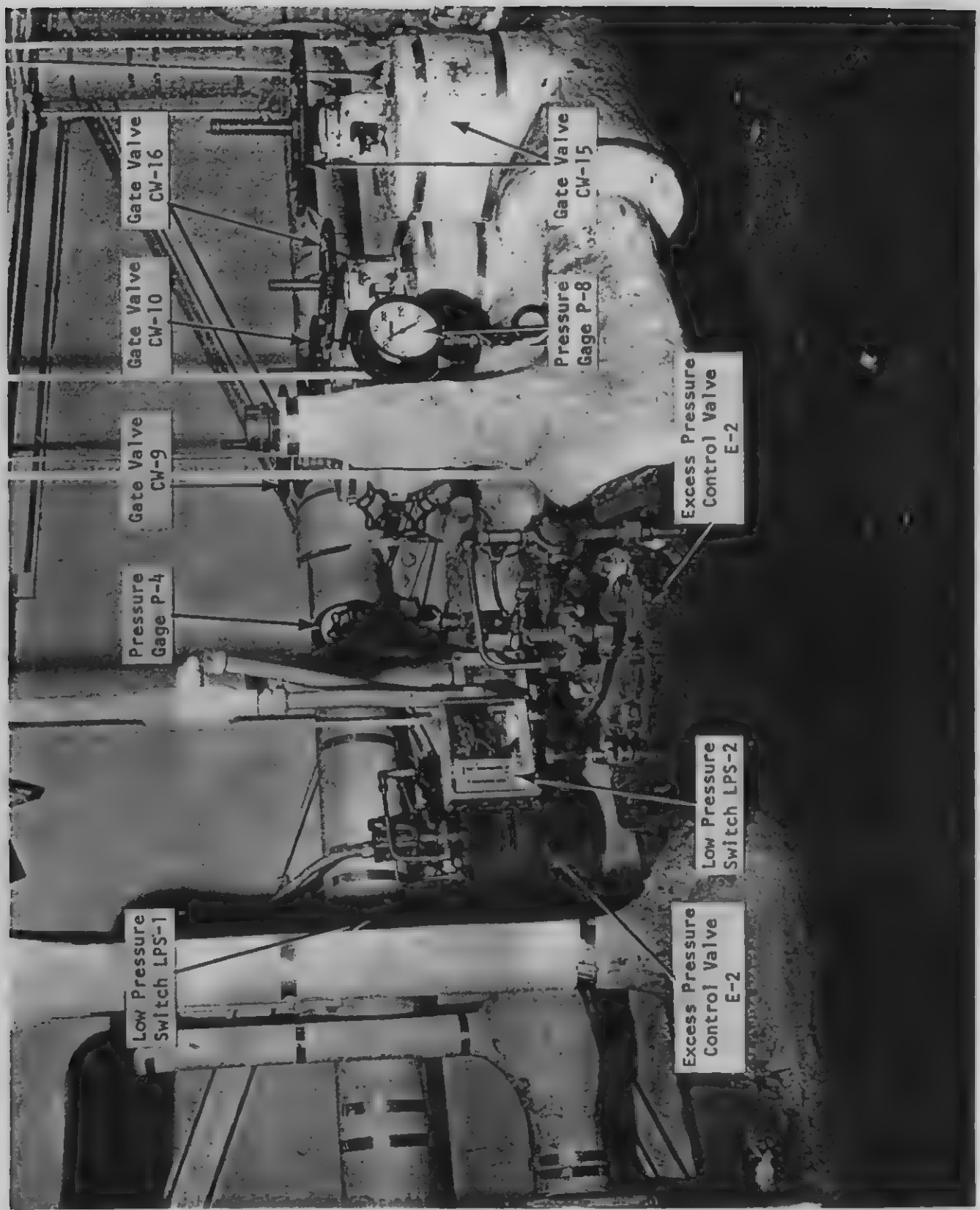


Figure 2.34 Pressure Reducing Valve Station
Partial View 3

Figure 2.35 Pressure Reducing Valve Station
Partial View 4

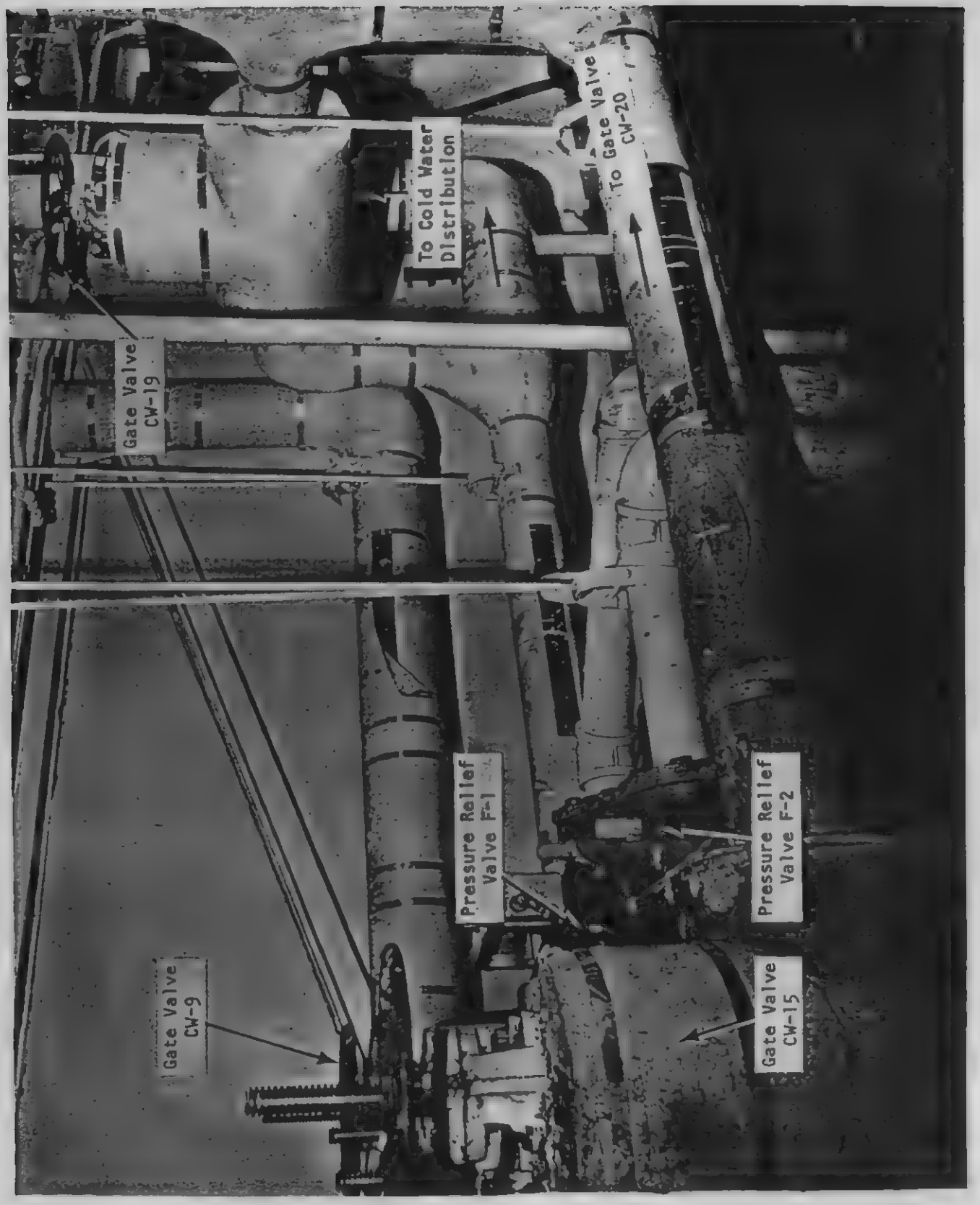
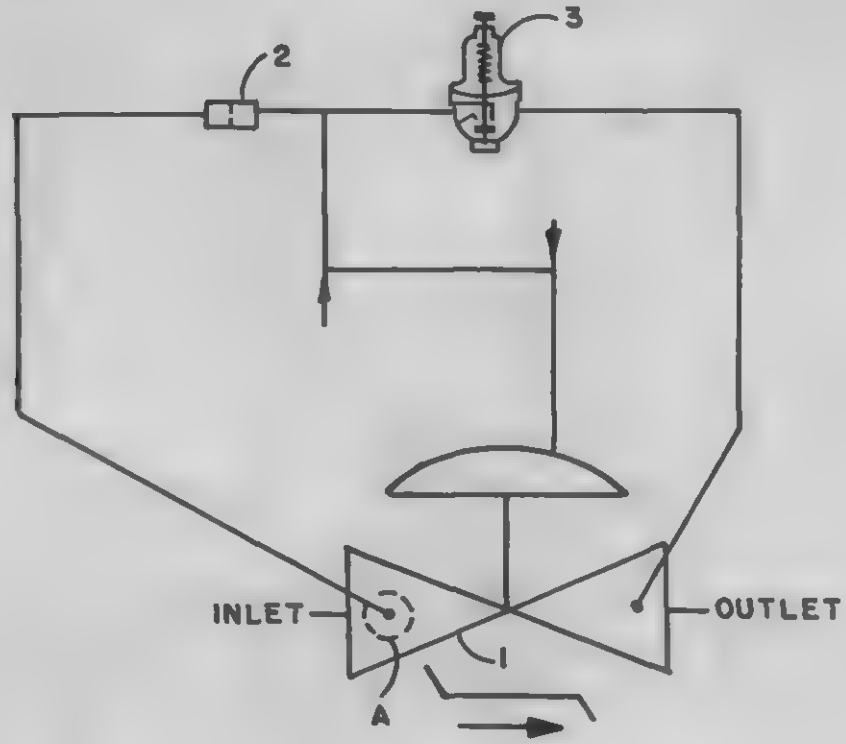


Figure 2.36 Pressure Reducing Valve Station
Partial View 5



LEGEND

Item No.	*Description*
1	Main Valve
2	Restriction Tube Fitting
3	Pressure Reducing Control
4	Flow Clean Strainer

Figure 2-37 Schematic Diagram
Pressure Reducing Valve

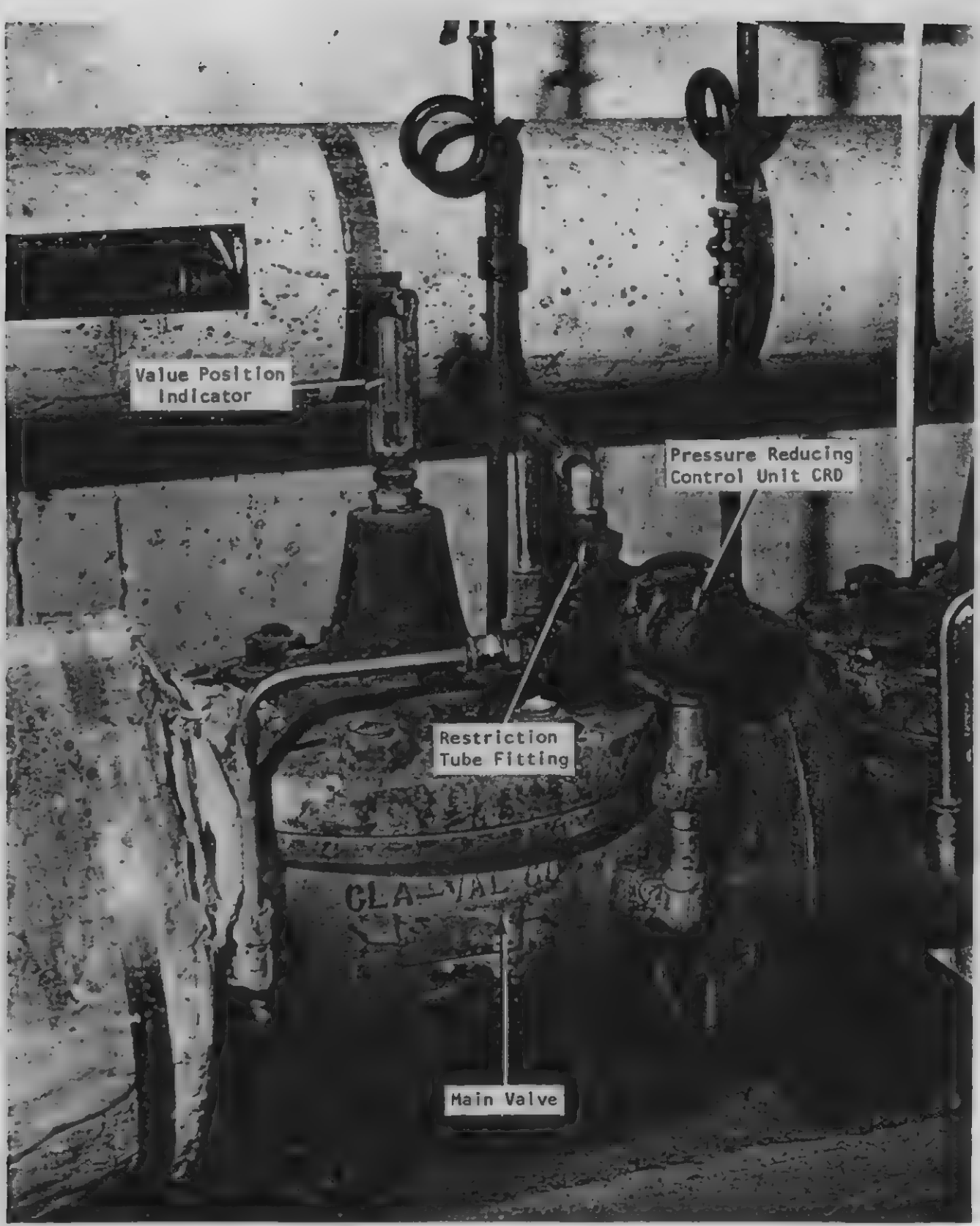
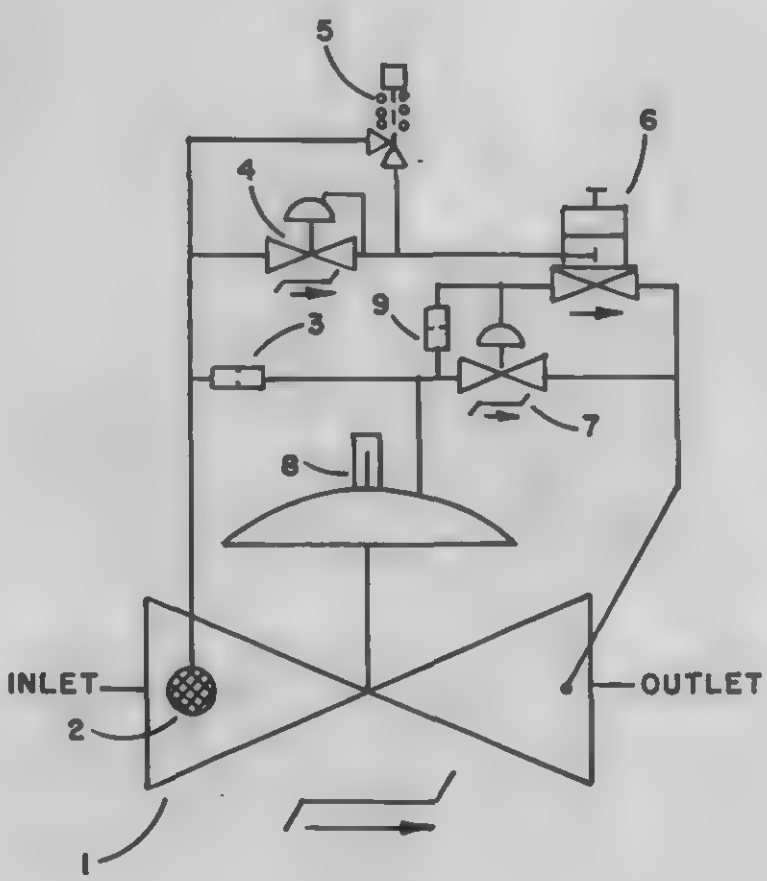


Figure 2.38 Typical Pressure Reducing Valve

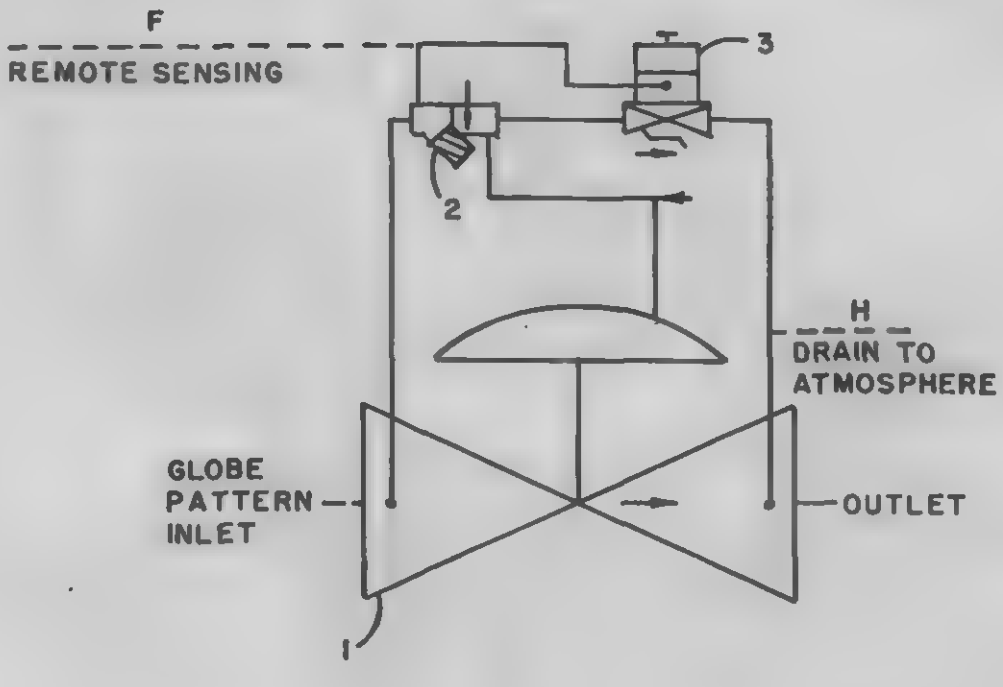


LEGEND

Item No.	*Description*
1	Main Valve
2	Flow Clean Strainer
3	Restriction Tube Fitting
4	Check Valve
5	Pushbutton Valve
6	Pressure Reducing Control
7	Auxiliary Valve
8	Valve Position Indicator
9	Restriction Tube Fitting

Figure 2-39 Schematic Diagram
Excess Pressure Control Valve

Figure 2.40 Typical Excess Pressure Control Valve



LEGEND

Item No.	*Description*
1	Main Valve
2	Needle Valve
3	Pressure Relief Control

Figure 2-41 Schematic Diagram
Pressure Relief Control Valve

Figure 2.42 Typical Pressure Relief Control Valve

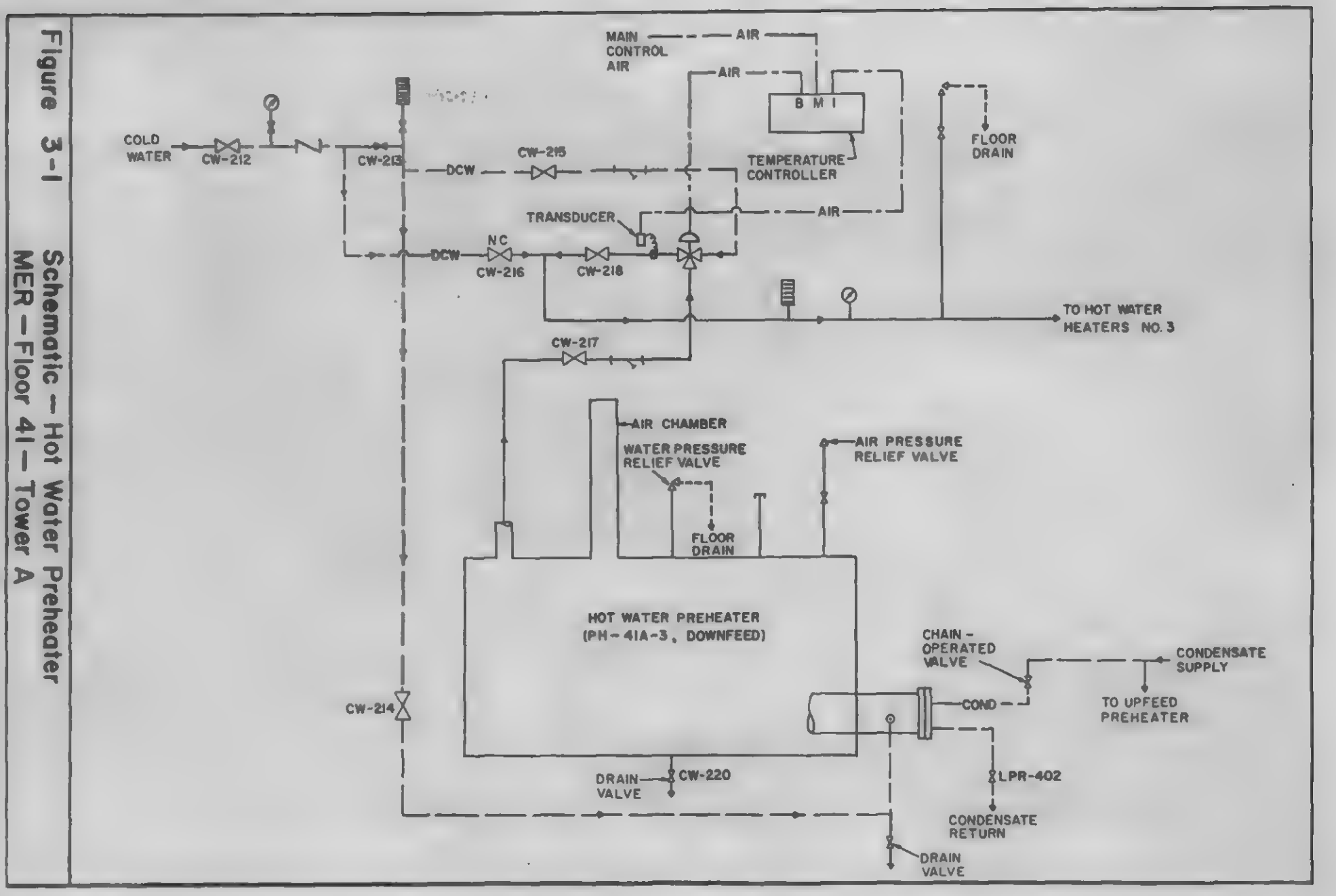


Figure 3-1 Schematic — Hot Water Preheater MER — Floor 41 — Tower A

Figure 3.2 Hot Water Preheater
View 1

Figure 3.3 Hot Water Preheater
View 2

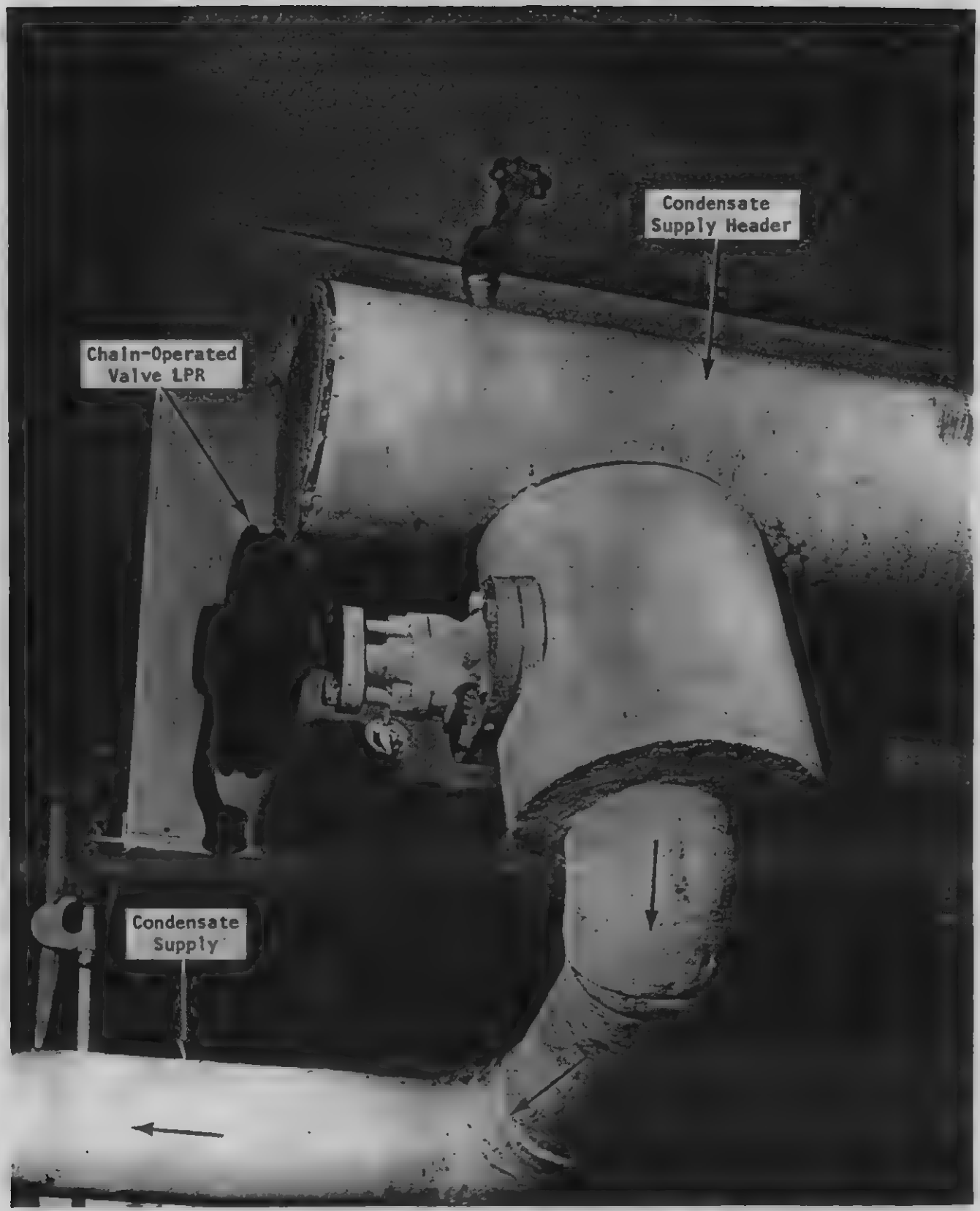


Figure 3.4 Condensate Supply Header

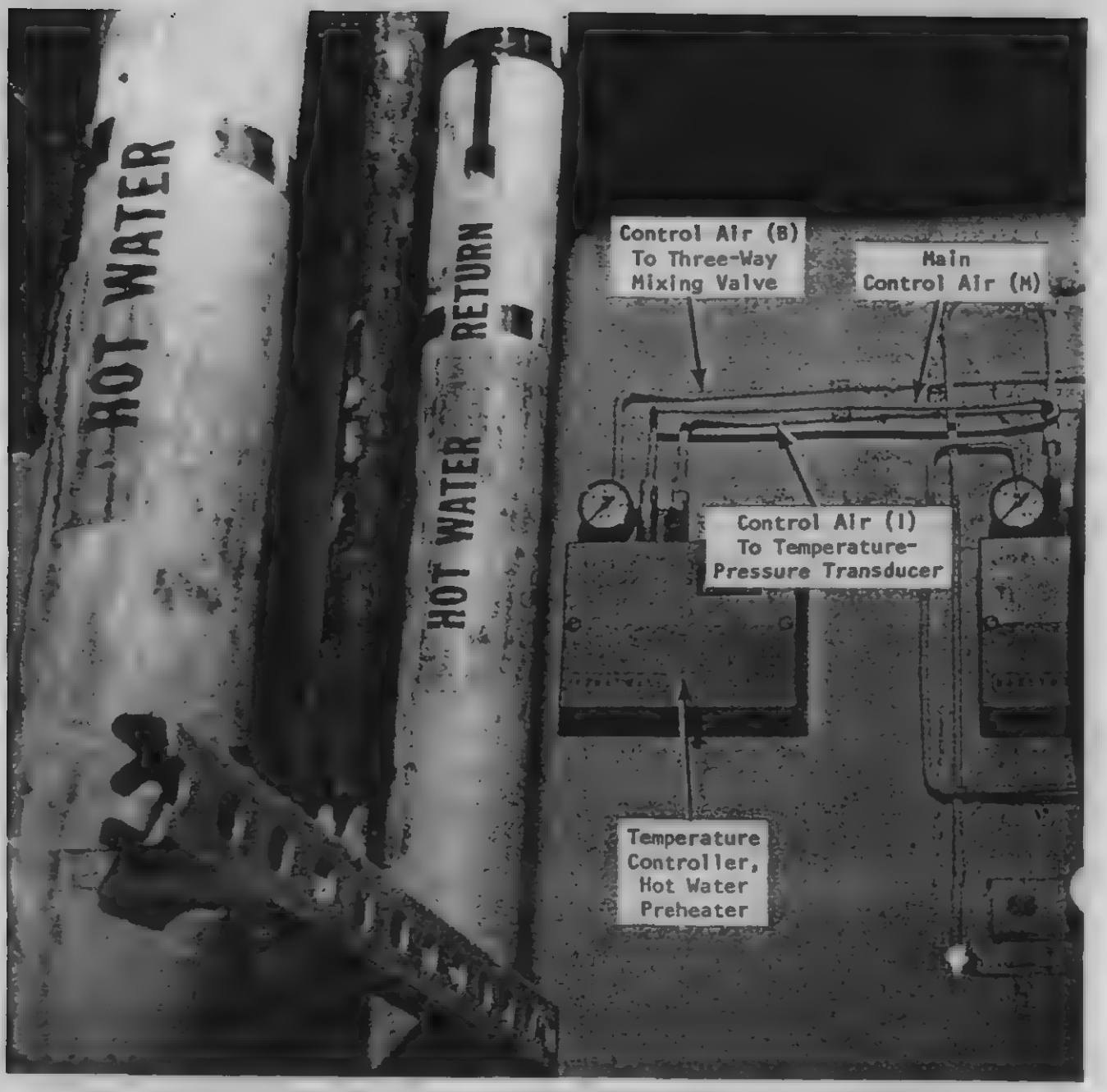


Figure 3.5 Three-way Mixing Valve and
Temperature-Pressure Transducer

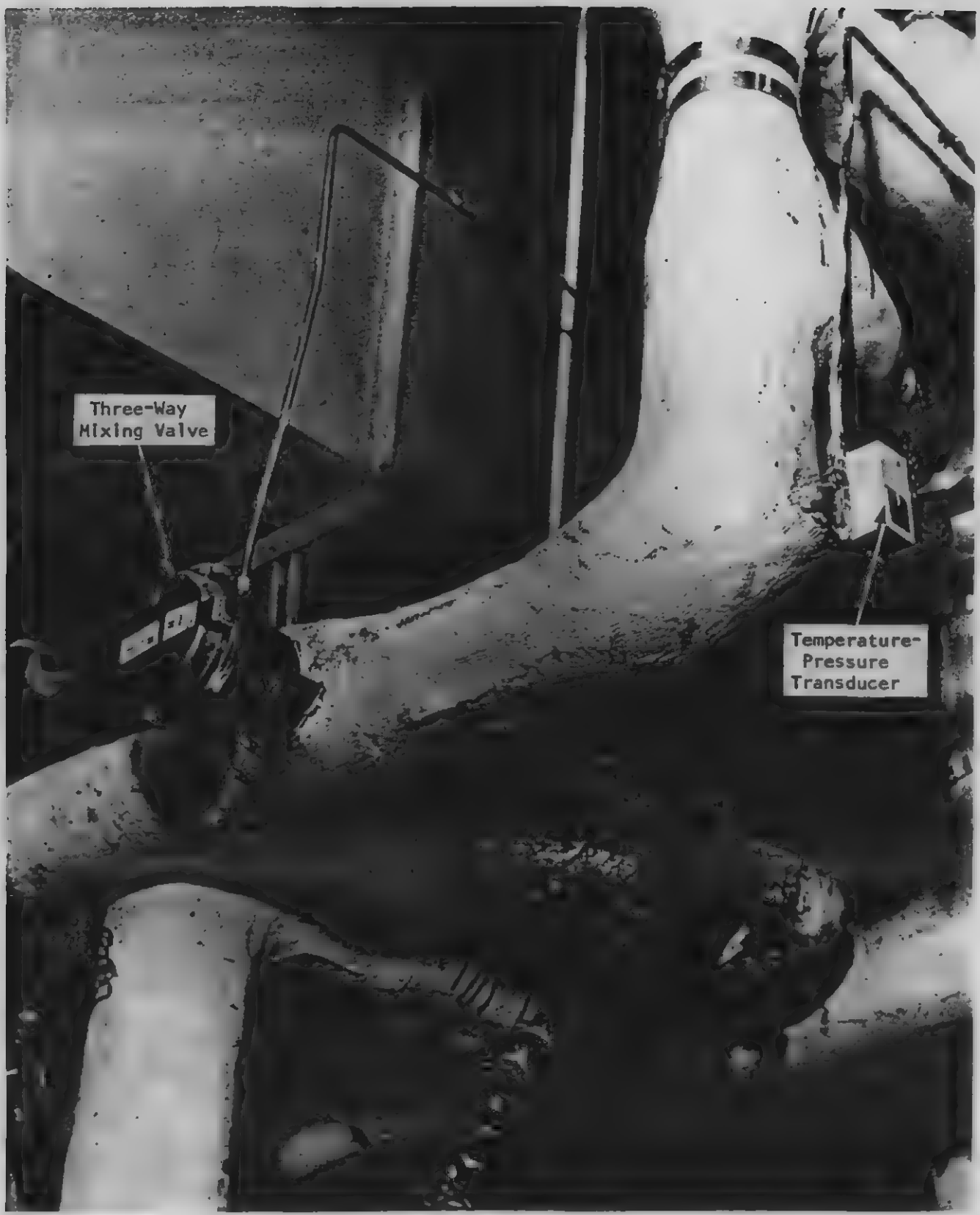


Figure 3.6 Temperature Controller
Hot Water Preheater

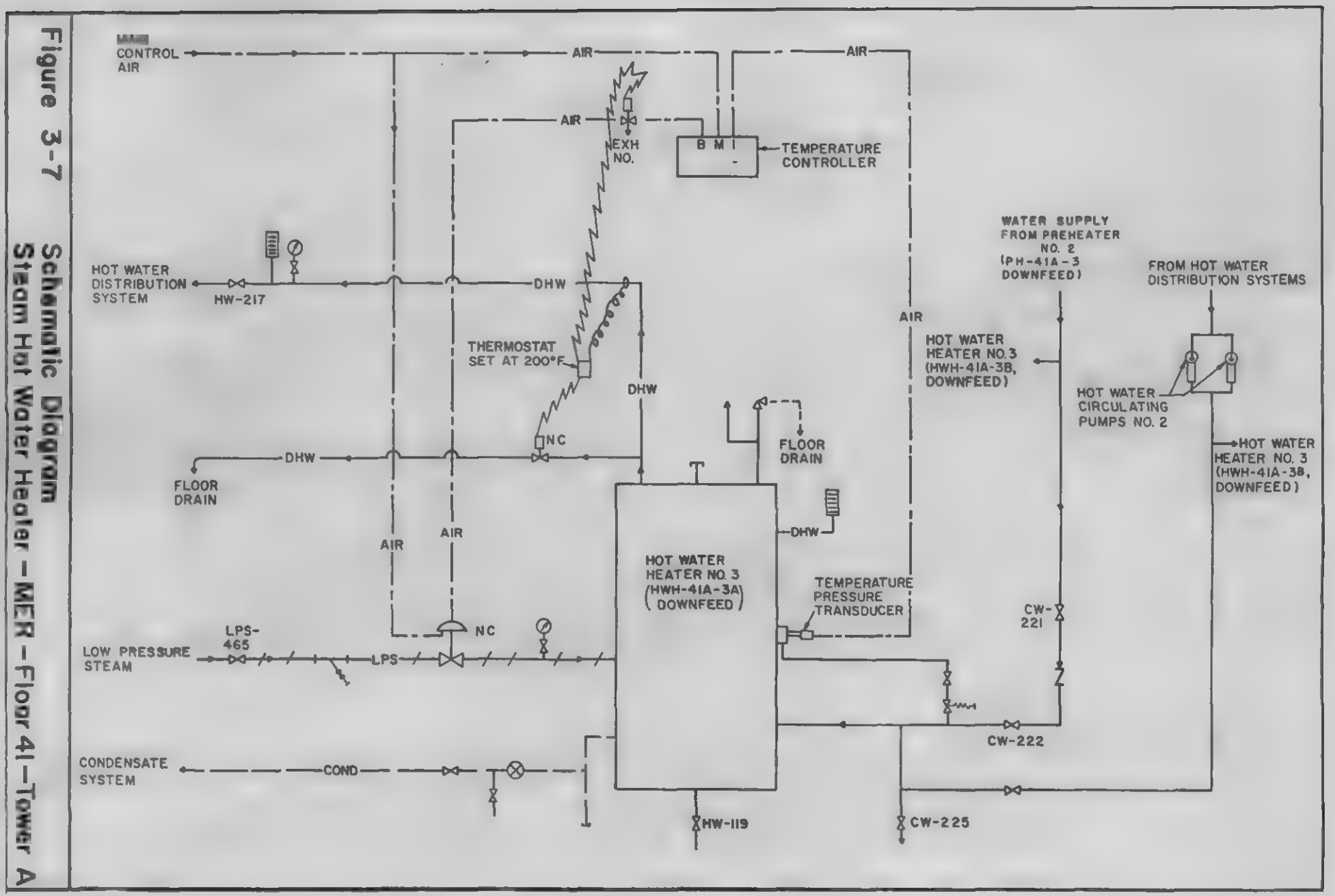


Figure 3-7 Schematic Diagram
Steam Hot Water Heater – MER – Floor 41 – Tower A

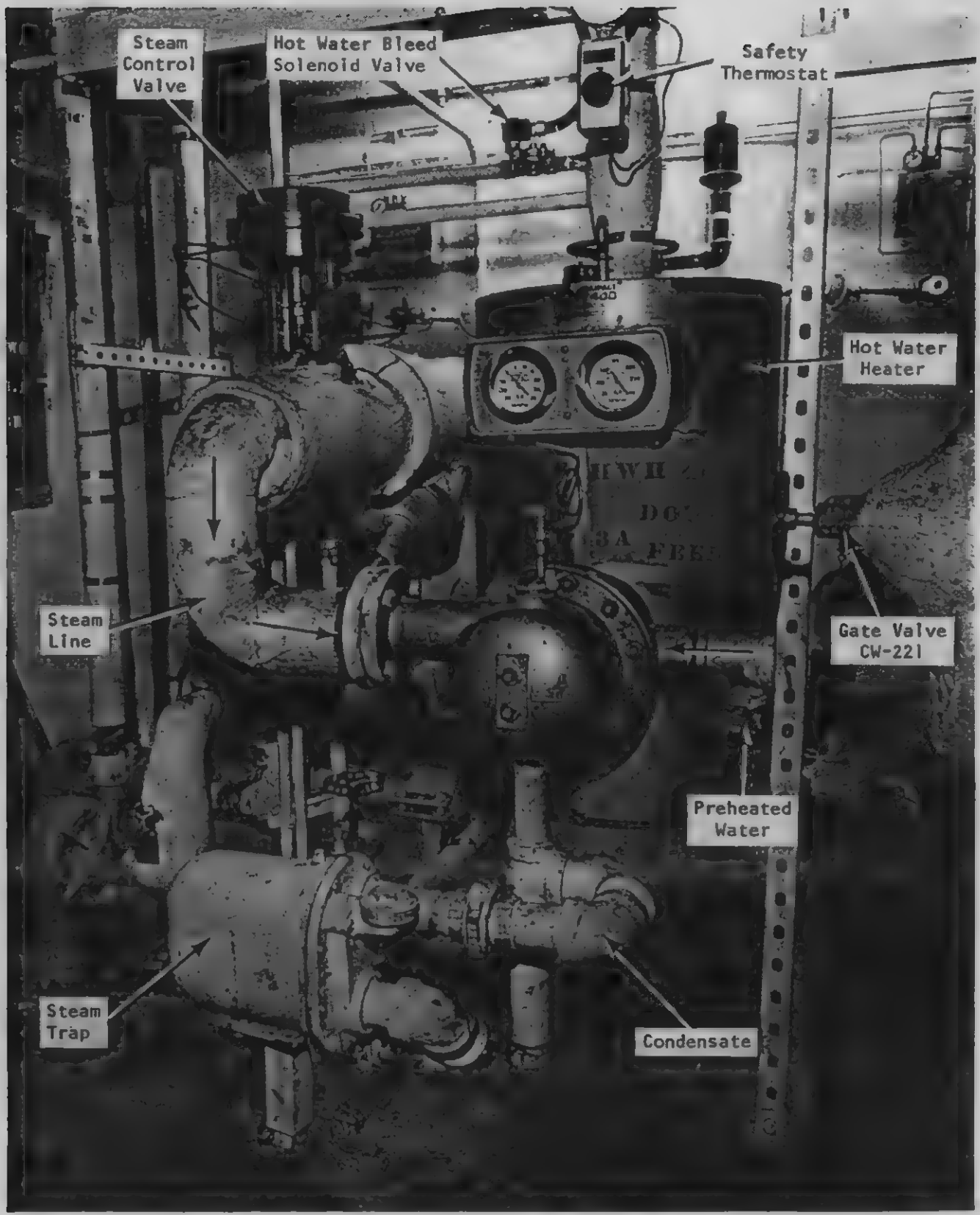


Figure 3.8 Steam Hot Water Heater
View 1

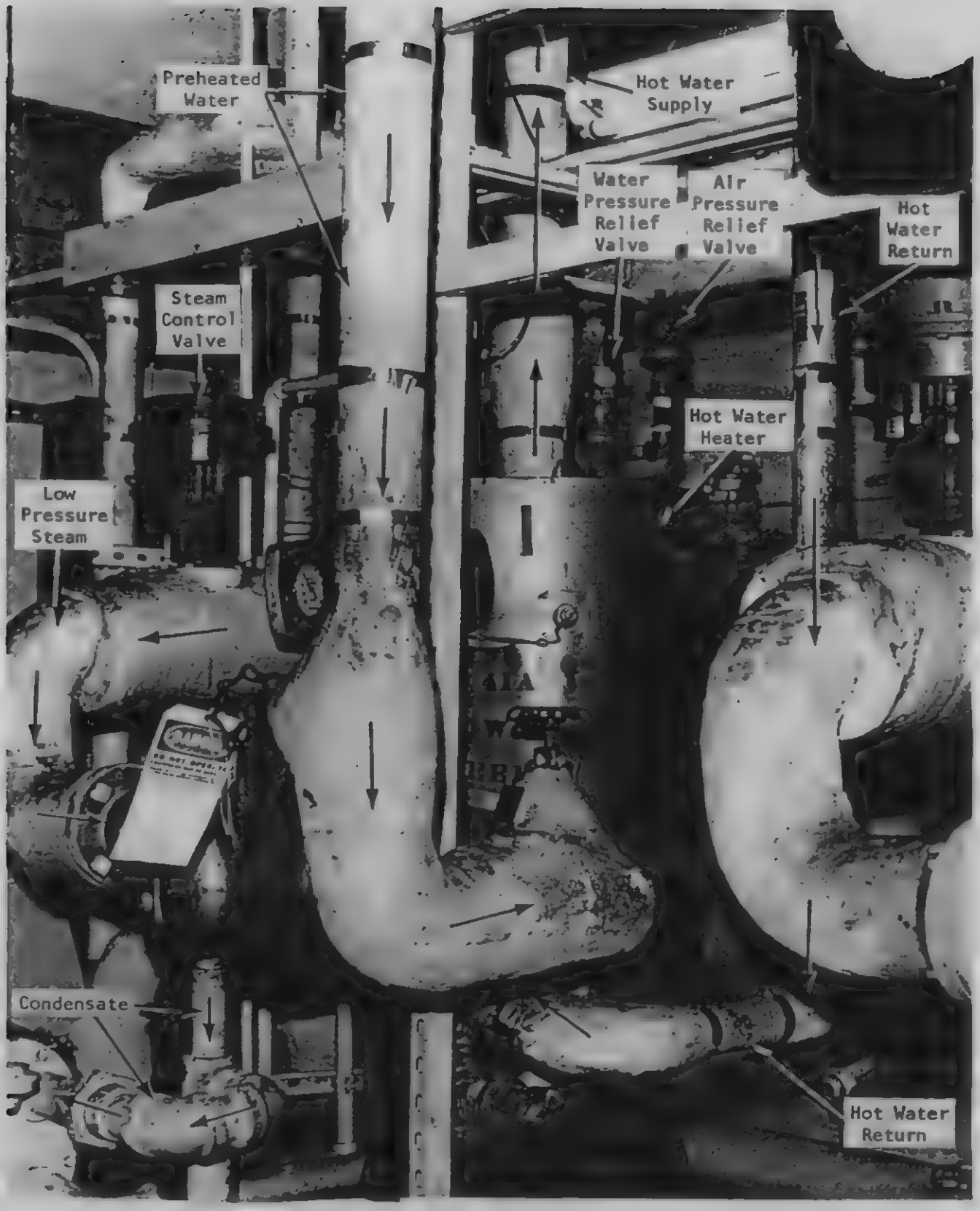


Figure 3.9 Steam Hot Water Heater
View 2

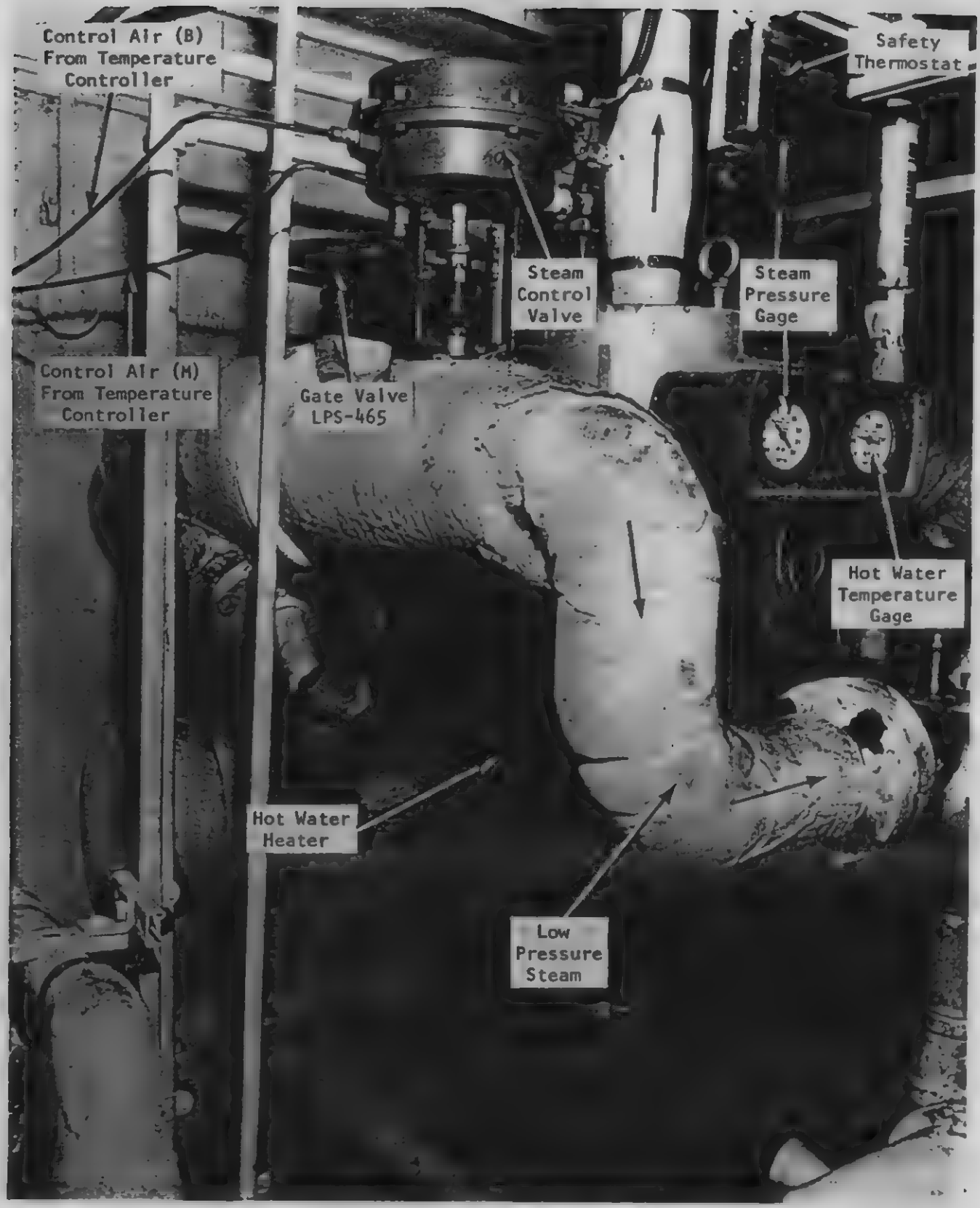


Figure 3.10 Steam Hot Water Heater
View 3

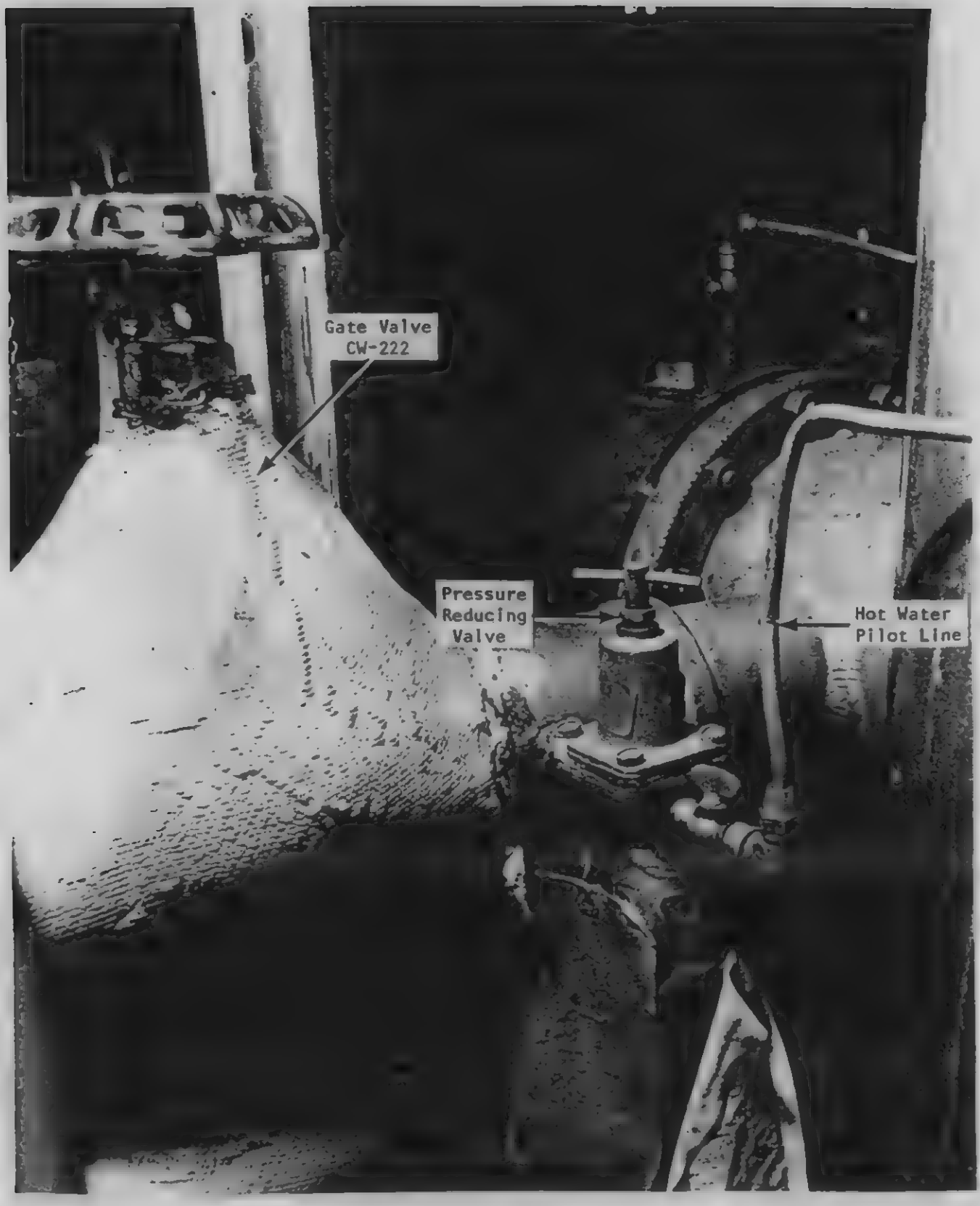


Figure 3.11 Steam Hot Water Heater Controls-1

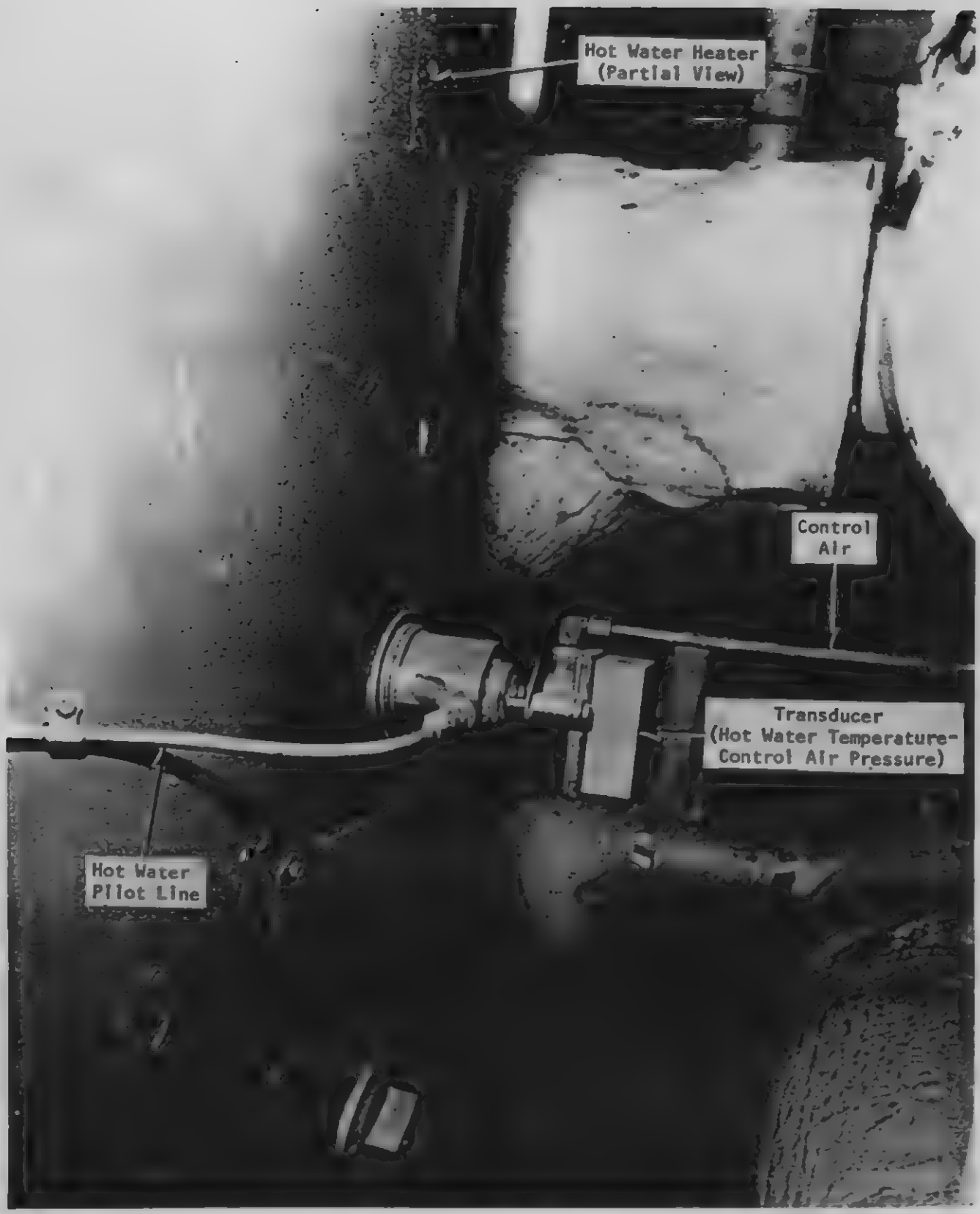


Figure 3.12 Steam Hot Water Heater Controls-2

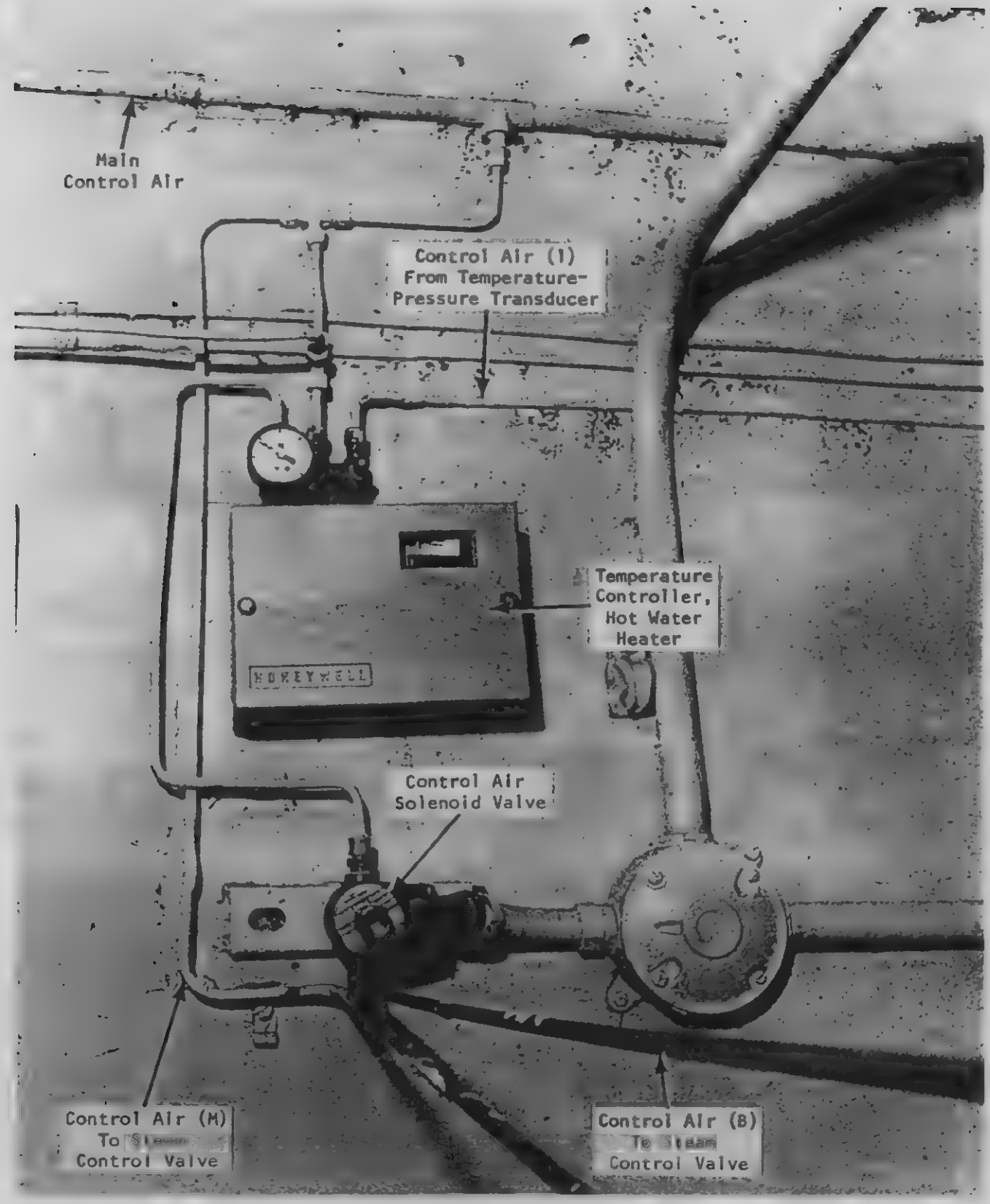
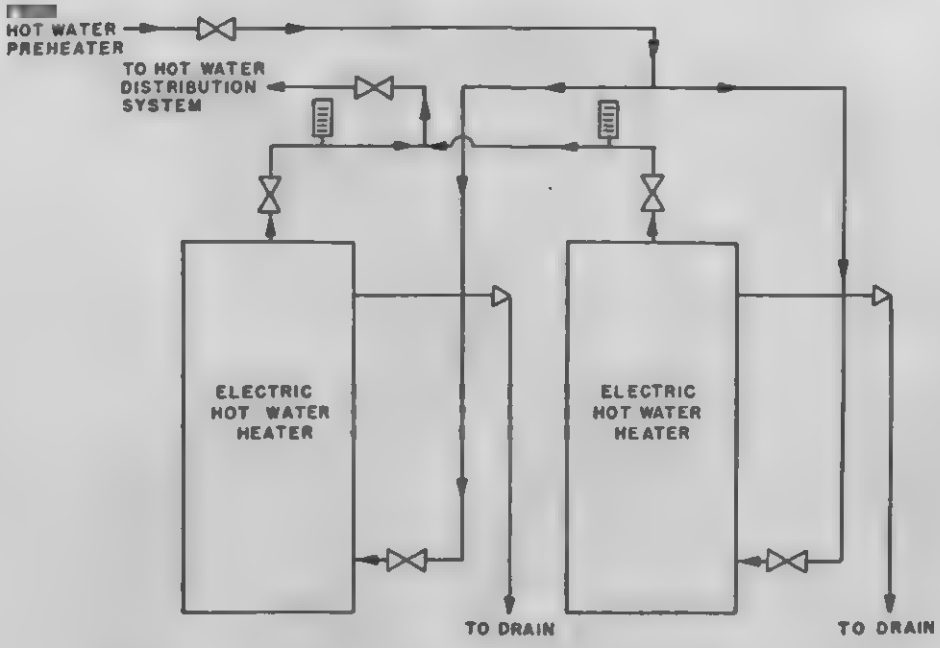
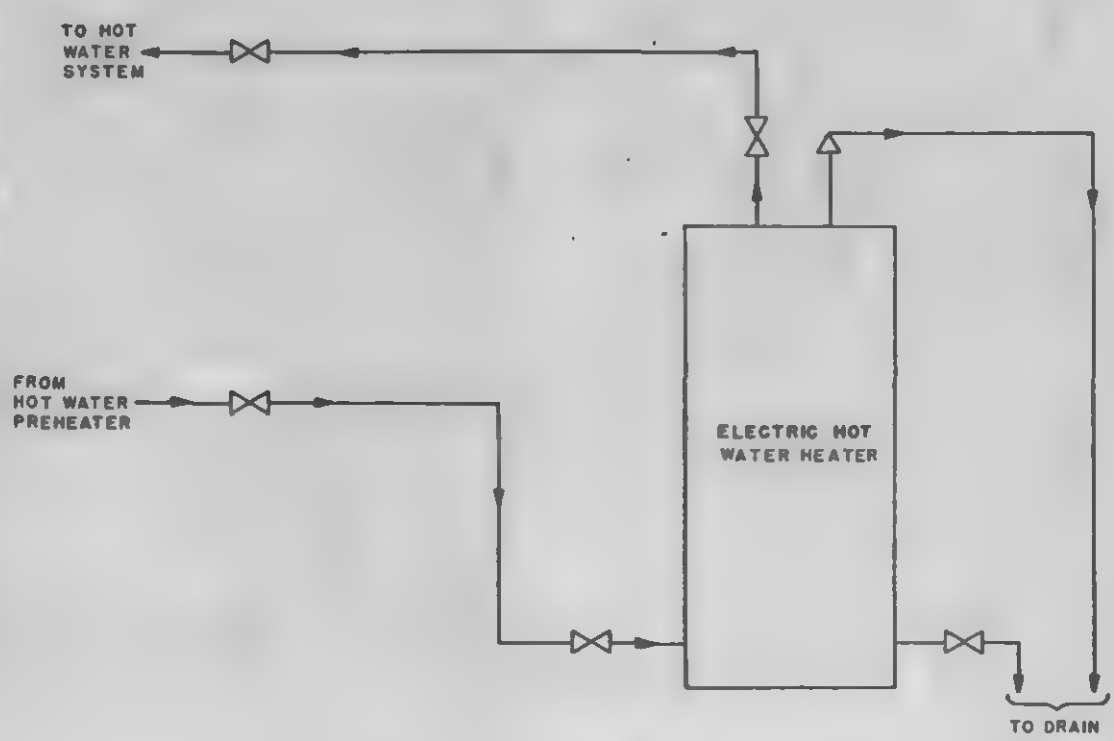


Figure 3.13 Steam Hot Water Heater Controls-3



ELECTRIC HOT WATER HEATER ARRANGEMENT — FLOOR 7



ELECTRIC HOT WATER HEATER ARRANGEMENT — FLOOR 75

Figure 3-14 Electric Hot Water Heater Arrangements Floors 7 And 75 MERs

Figure 3.15 Electric Hot Water Heaters
Floor 7 - MER

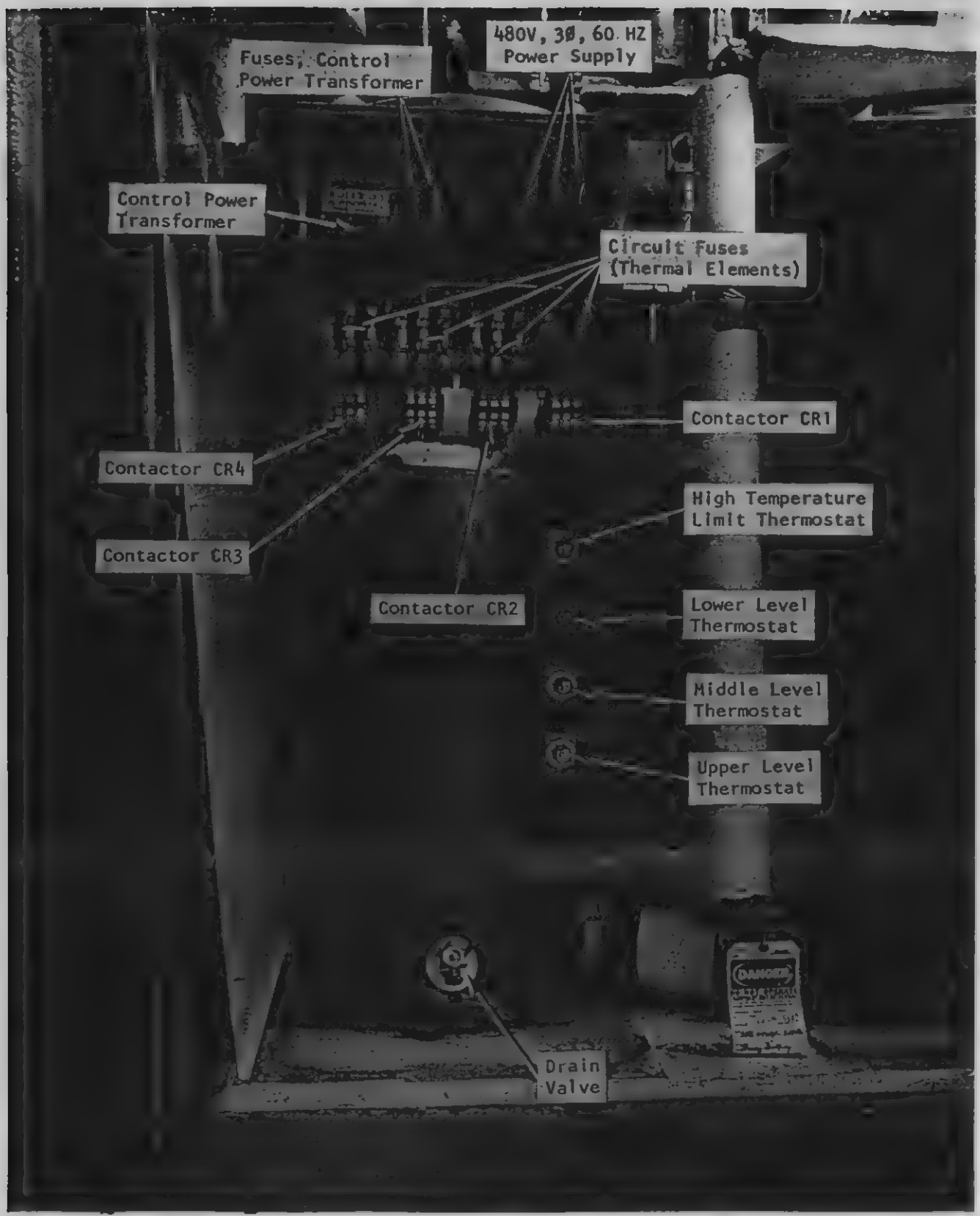


Figure 3.16 Electric Hot Water Heater
Interior View - Floor 7 - MER

Figure 3.17 Thermal and Pressure Relief Valves
Electric Hot Water Heaters - Floor 7 - MER

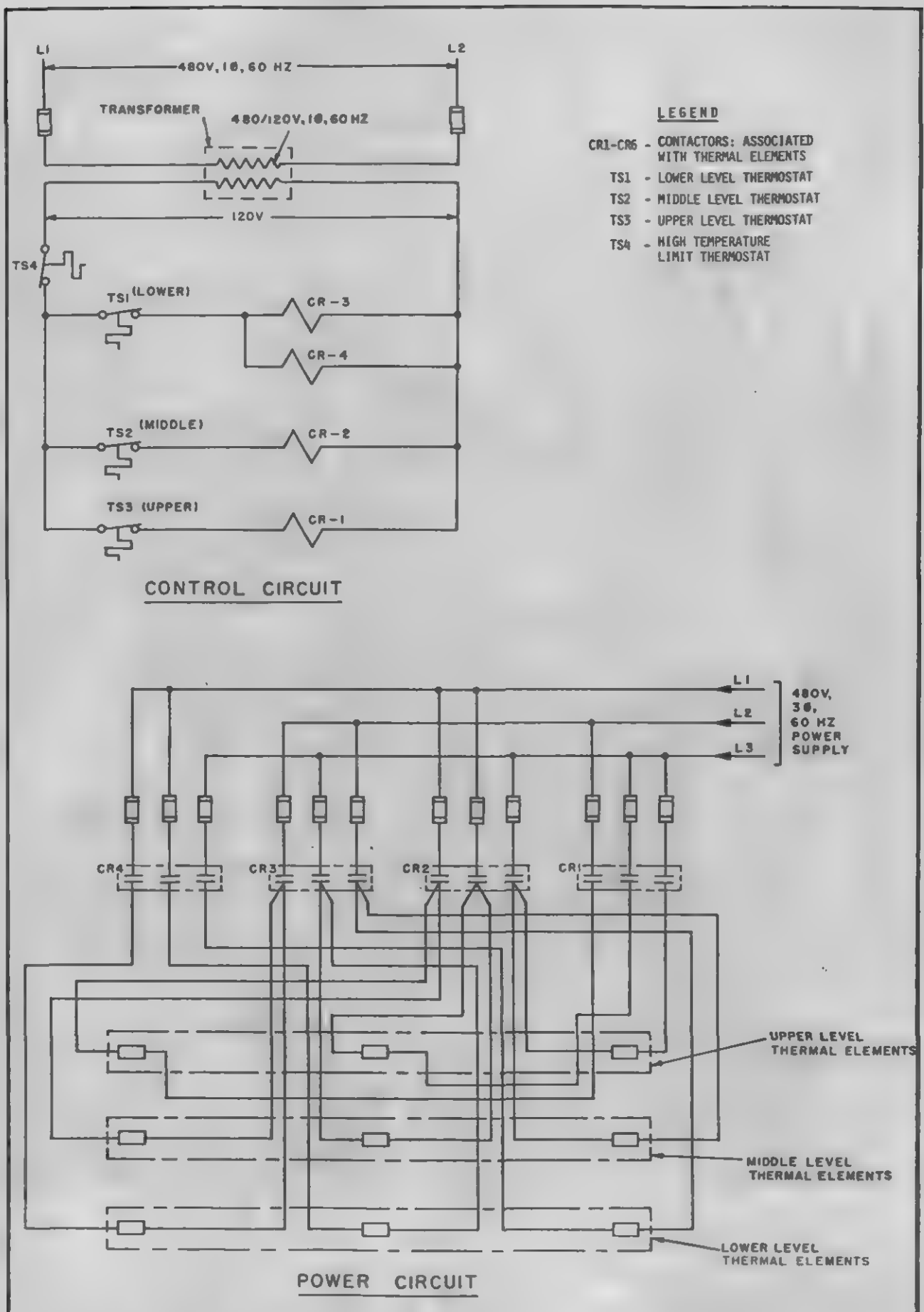


Figure 3-18 Schematic Diagrams
Electric Hot Water Heaters—Floor 7-MER

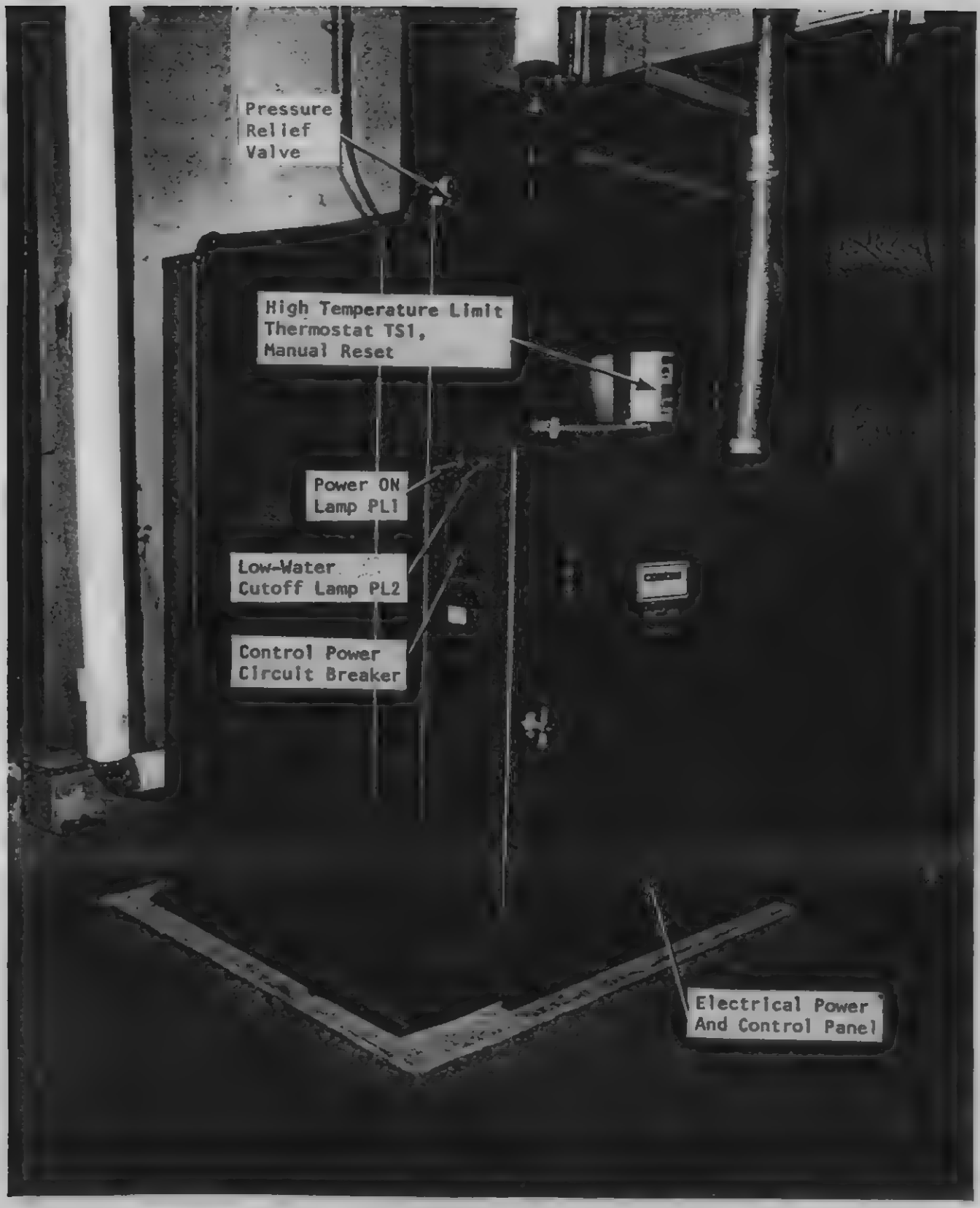


Figure 3.19 Electric Hot Water Heater
105 KW - Floor 75 - MER

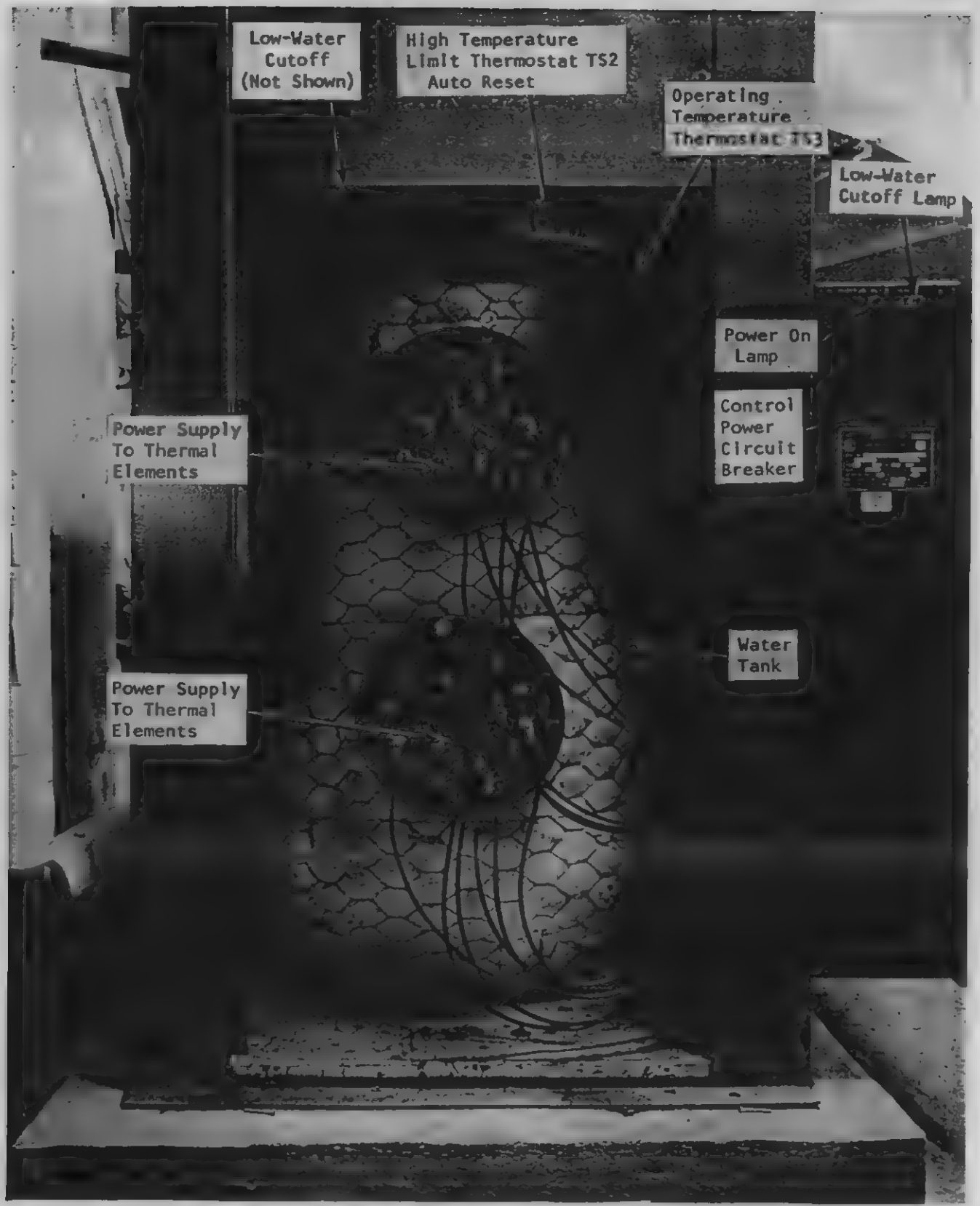


Figure 3.20 Electric Hot Water Heater - 105 KW
Interior View - Floor 75 - MER

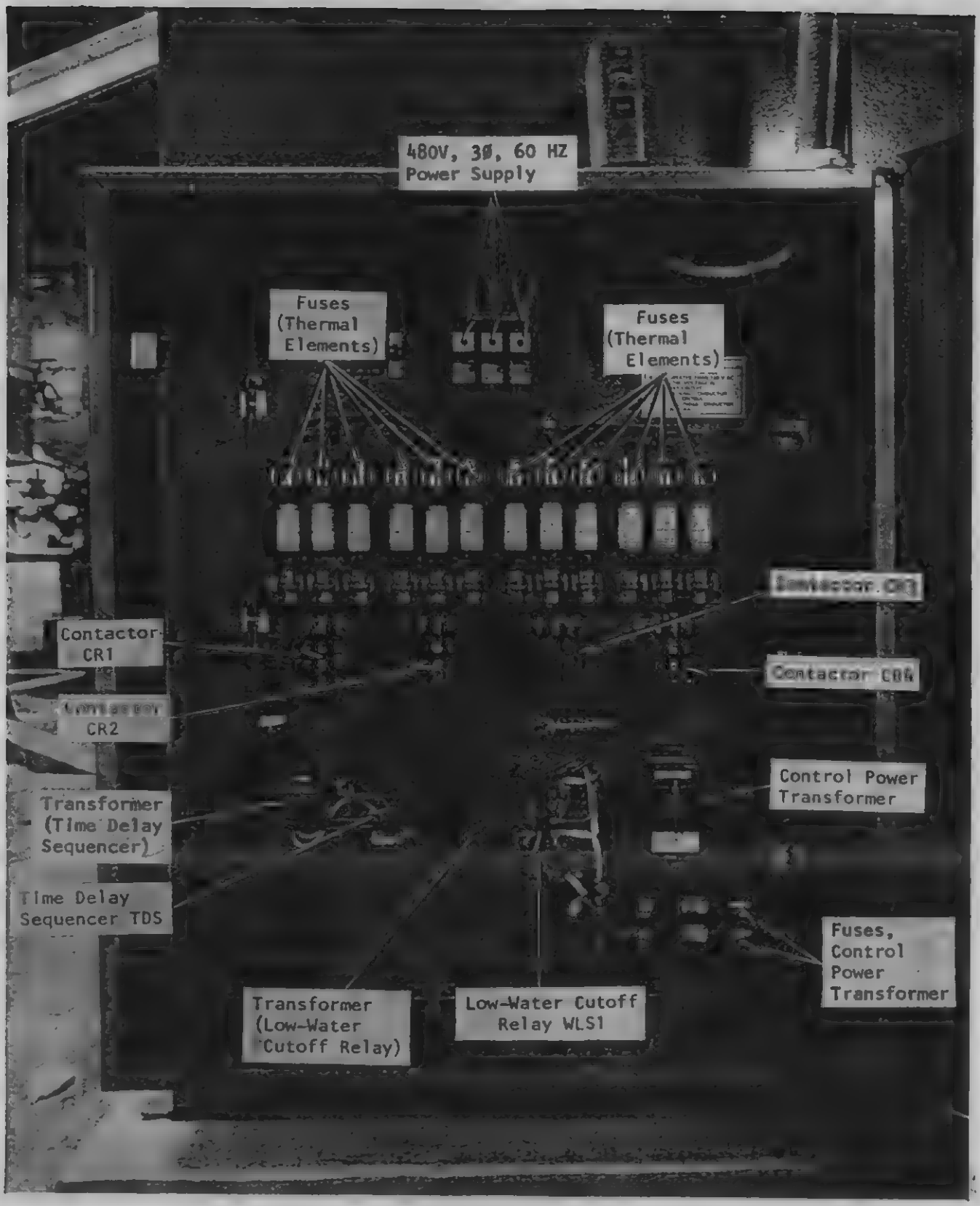


Figure 3.21 Electric Power and Control Panel
Electric Hot Water Heater - 105 KW

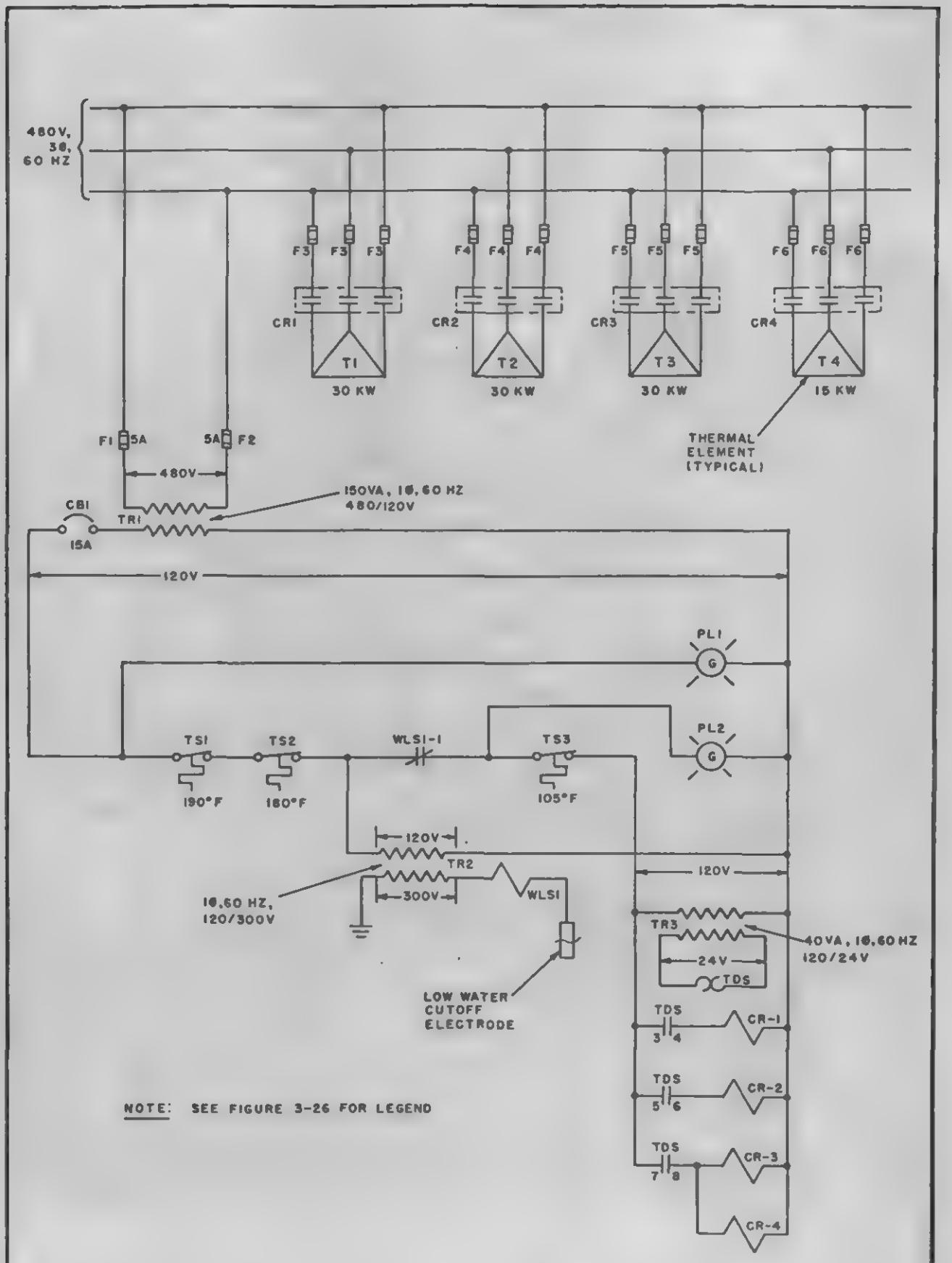


Figure 3-22 Schematic Diagram
Electric Hot Water Heater - 105 KW - Floor 75 - MER

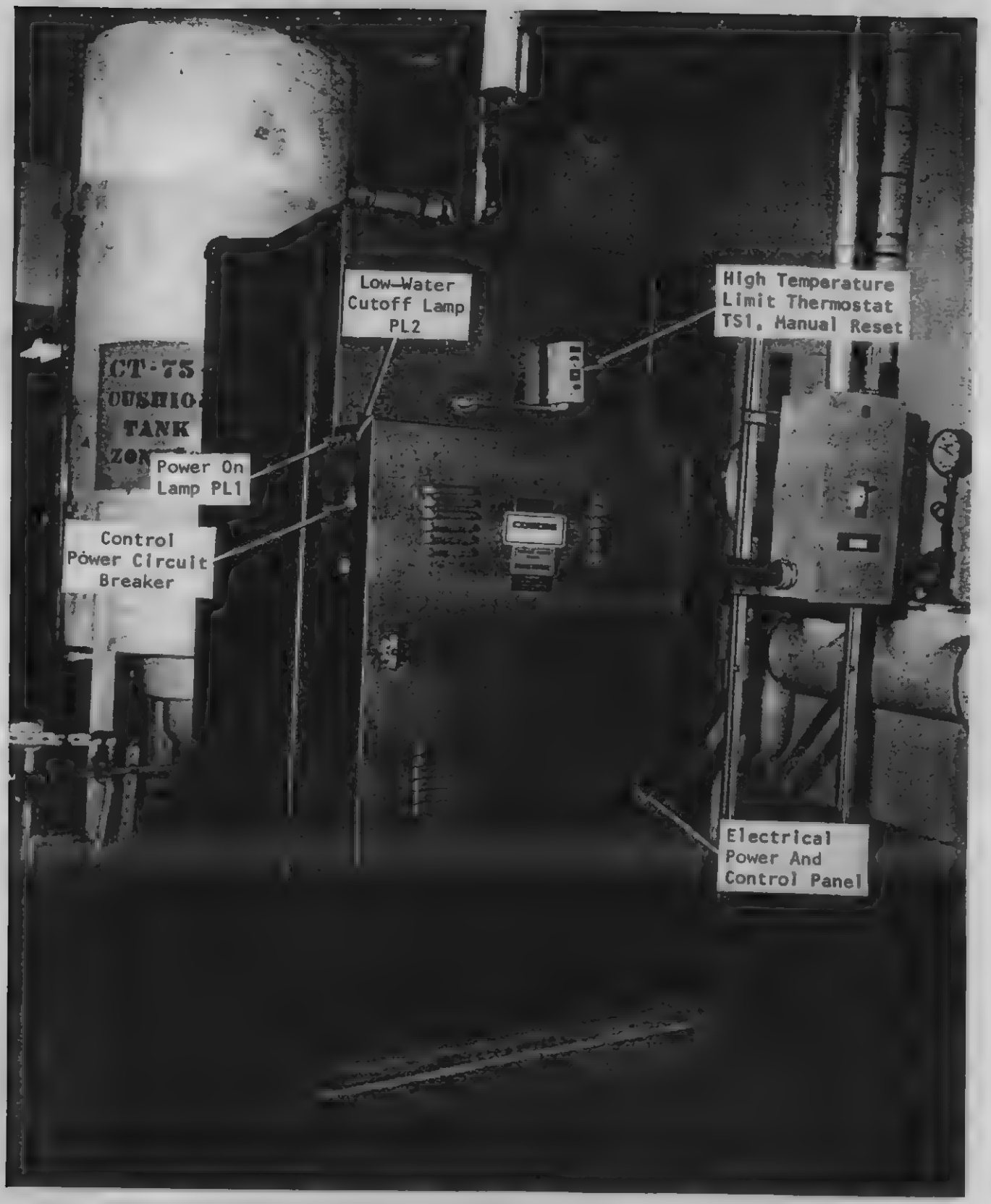


Figure 3.23 Electric Hot Water Heater
165 KW - Floor 75 - MER

Figure 3.24 Electric Hot Water Heater - 165 KW
Interior View - Floor 75 - MER

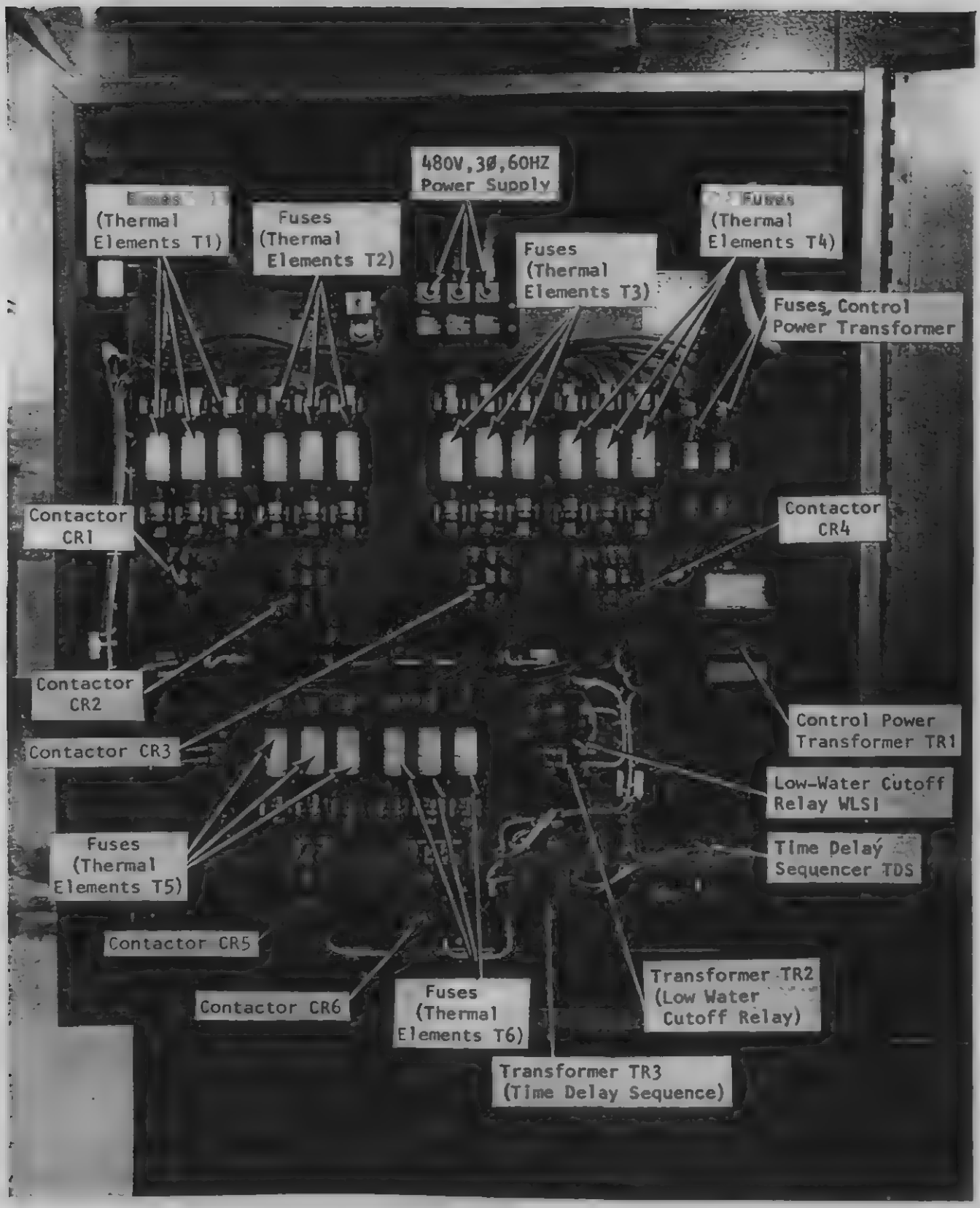
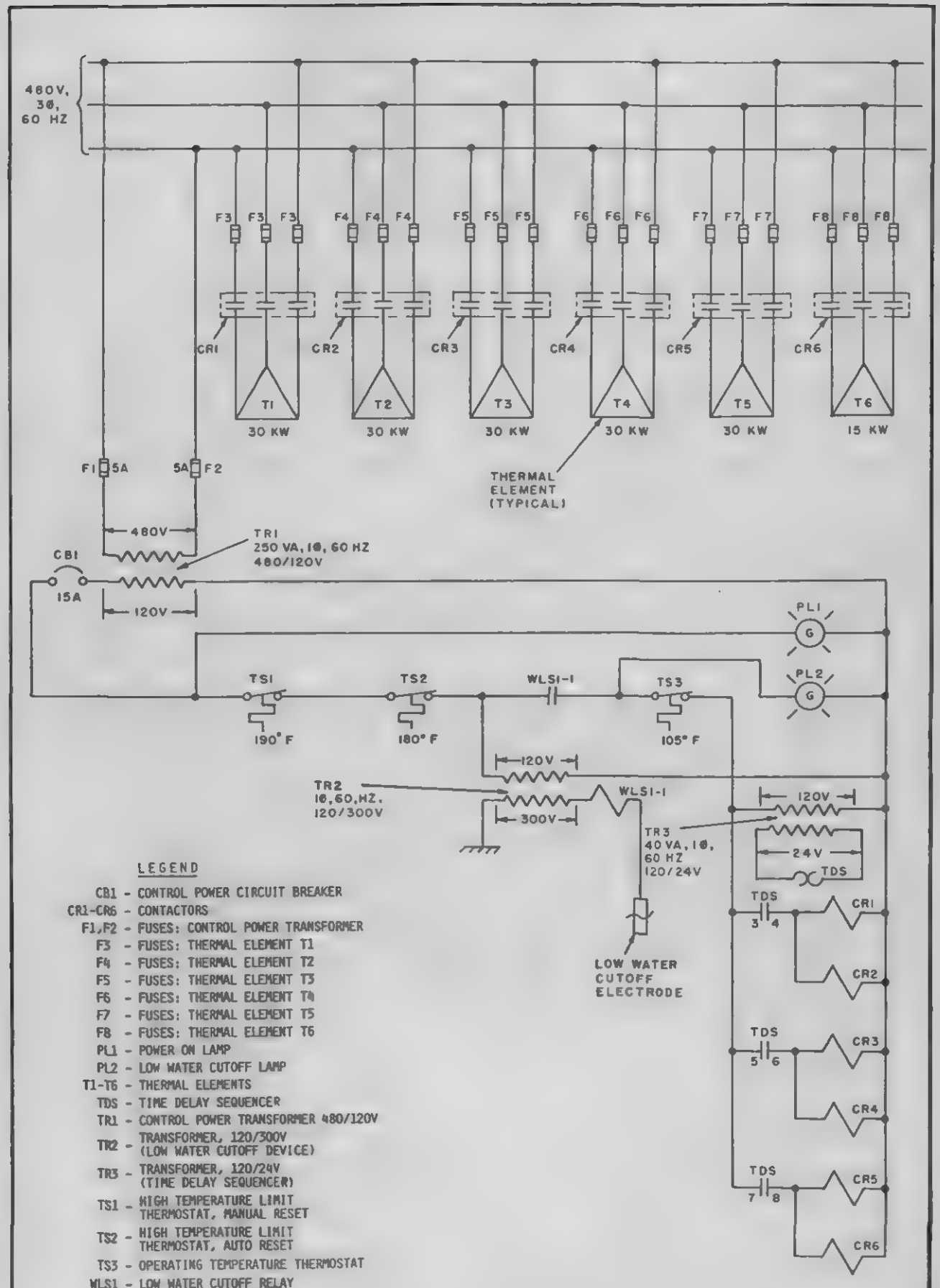


Figure 3.25 Electric Power and Control Panel
Electric Hot Water Heater - 165 KW



LEGEND

CB1	CONTROL POWER CIRCUIT BREAKER
CR1-CR6	CONTACTORS
F1,F2	FUSES: CONTROL POWER TRANSFORMER
F3	FUSES: THERMAL ELEMENT T1
F4	FUSES: THERMAL ELEMENT T2
F5	FUSES: THERMAL ELEMENT T3
F6	FUSES: THERMAL ELEMENT T4
F7	FUSES: THERMAL ELEMENT T5
F8	FUSES: THERMAL ELEMENT T6
PL1	POWER ON LAMP
PL2	LOW WATER CUTOFF LAMP
T1-T6	THERMAL ELEMENTS
TDS	TIME DELAY SEQUENCER
TR1	CONTROL POWER TRANSFORMER 480/120V
TR2	TRANSFORMER, 120/300V (LOW WATER CUTOFF DEVICE)
TR3	TRANSFORMER, 120/24V (TIME DELAY SEQUENCER)
TS1	HIGH TEMPERATURE LIMIT THERMOSTAT, MANUAL RESET
TS2	HIGH TEMPERATURE LIMIT THERMOSTAT, AUTO RESET
TS3	OPERATING TEMPERATURE THERMOSTAT
WLS1	LOW WATER CUTOFF RELAY

Figure 3-26 Schematic Diagram
Electric Hot Water Heater-165 KW-Floor 75-MER

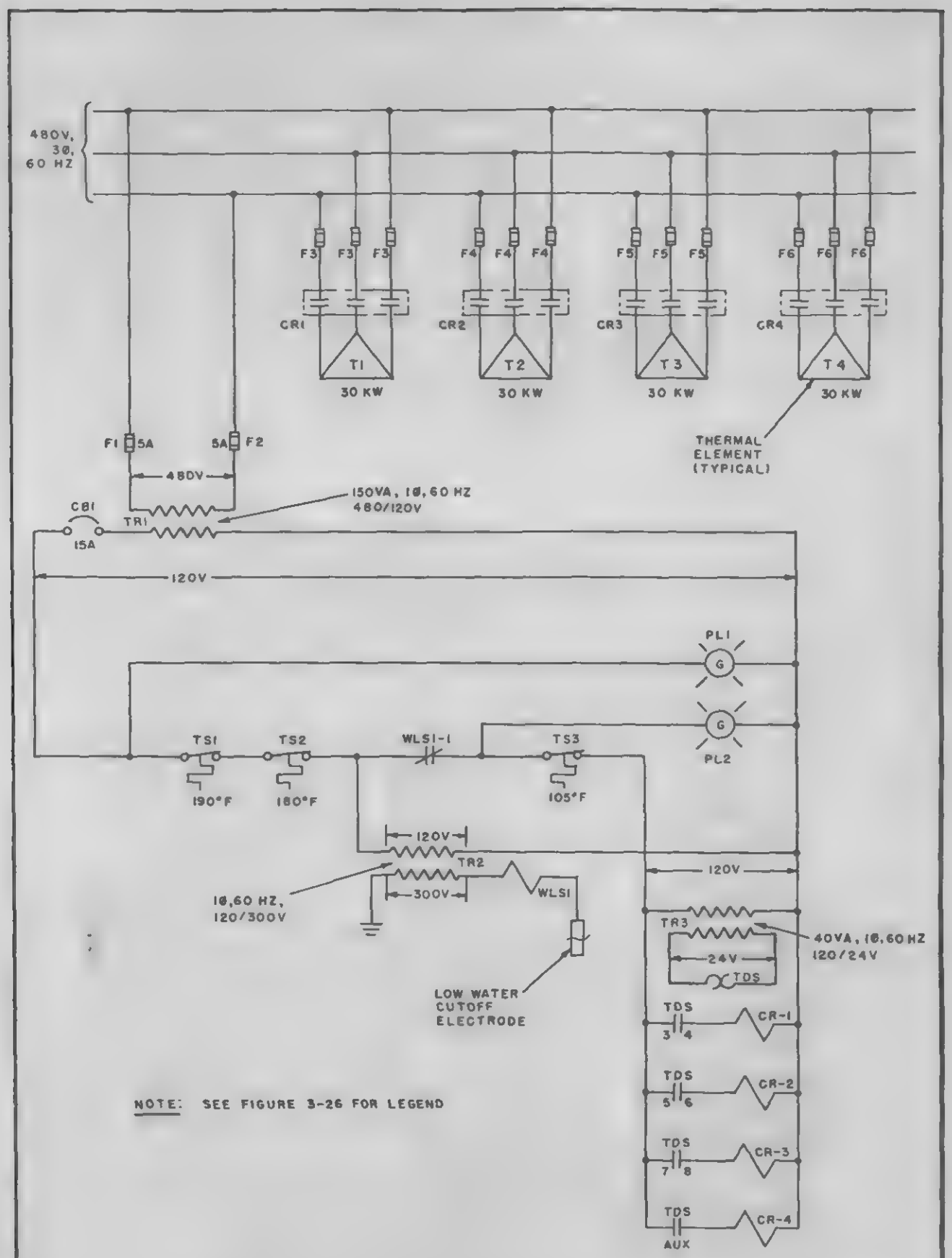


Figure 3-27 Schematic — Electric Hot Water Heater — 120 KW
Floor 108 — MER — Tower B

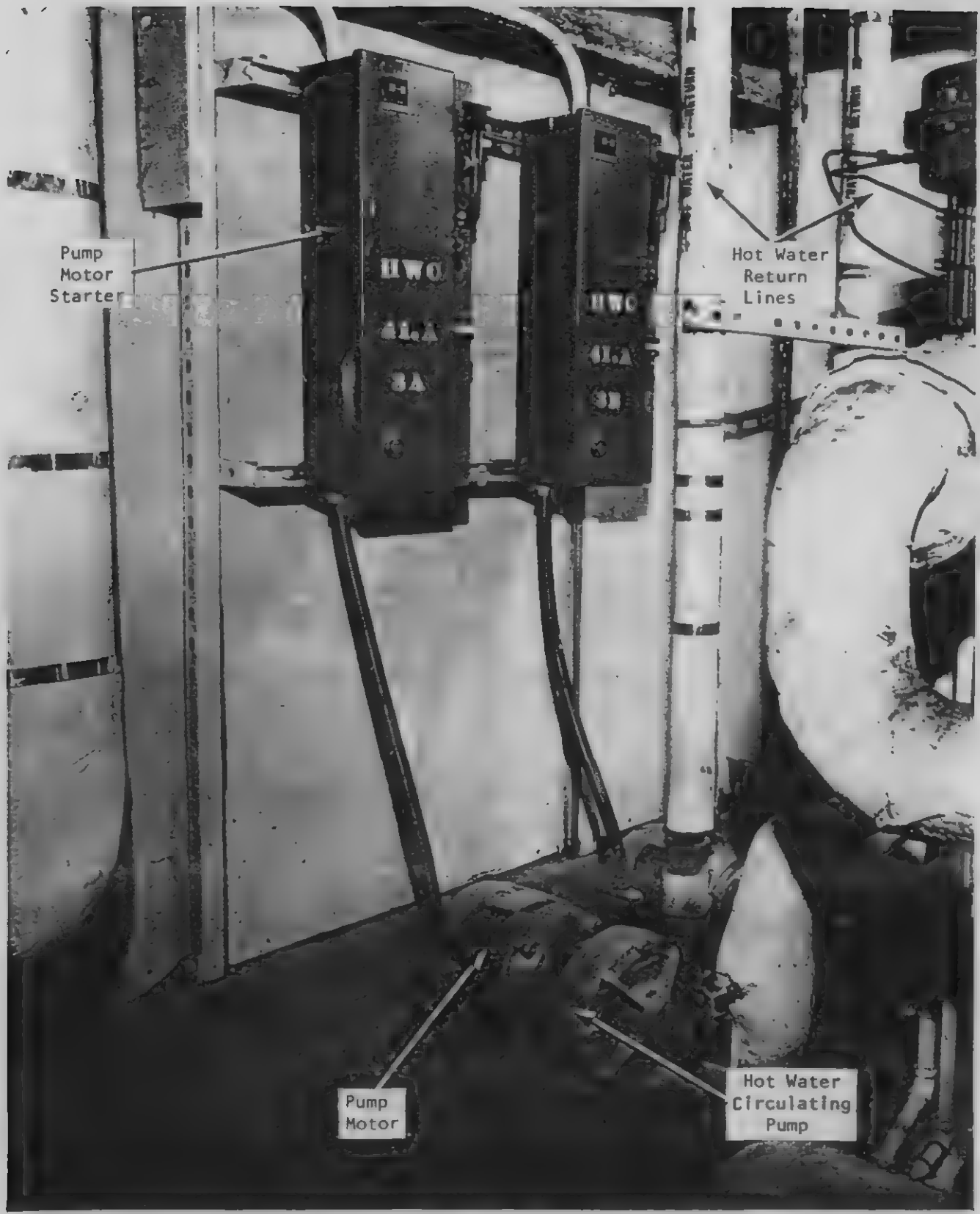


Figure 3.28 Hot Water Circulating Pumps

Domestic Cold Water

Domestic Hot Water

Domestic Hot Water, Circulating

M.R. — Men's Room

P1, P1A, P1B, P2, P2A, P3, P4, P4A, P5, P5A, P6, P6A, P7, P7A, P8 — Domestic Cold Water Supply Systems

P1, P1A, P1B, P2, P2A, P3, P4, P4A, P5, P5A, P6, P7, P7A, P8 — Domestic Hot Water Supply Systems

P2, P4A, P5A, P6, P6A, P7 — Domestic Hot Water, Circulating

S.S. — Slop Sink

W.R. — Women's Room

Figure 4-1 Legend
Domestic Water Distribution System

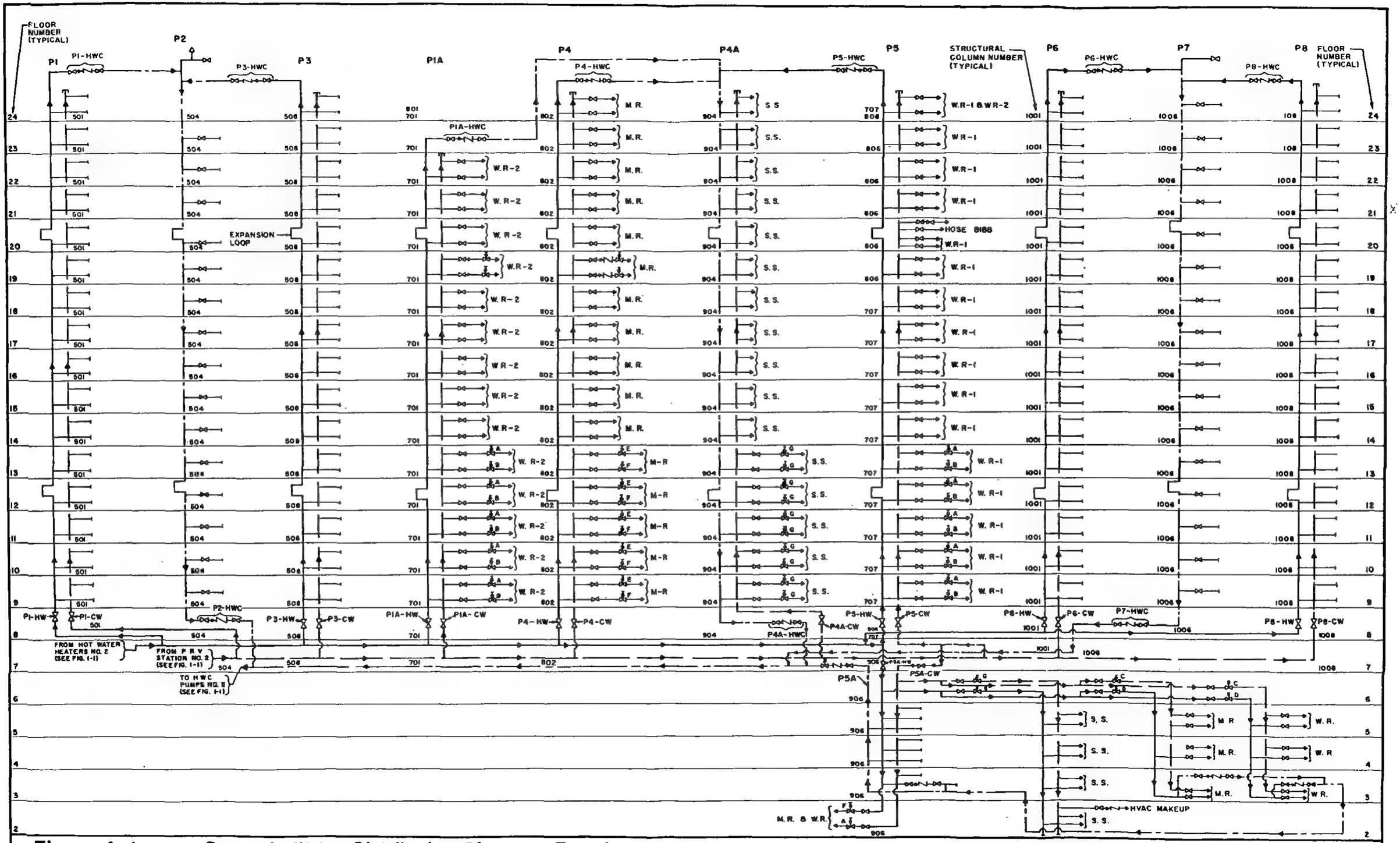


Figure 4-1a **Domestic Water Distribution Diagram — Zone 1**
Floors 2 Thru 24 — Towers A & B

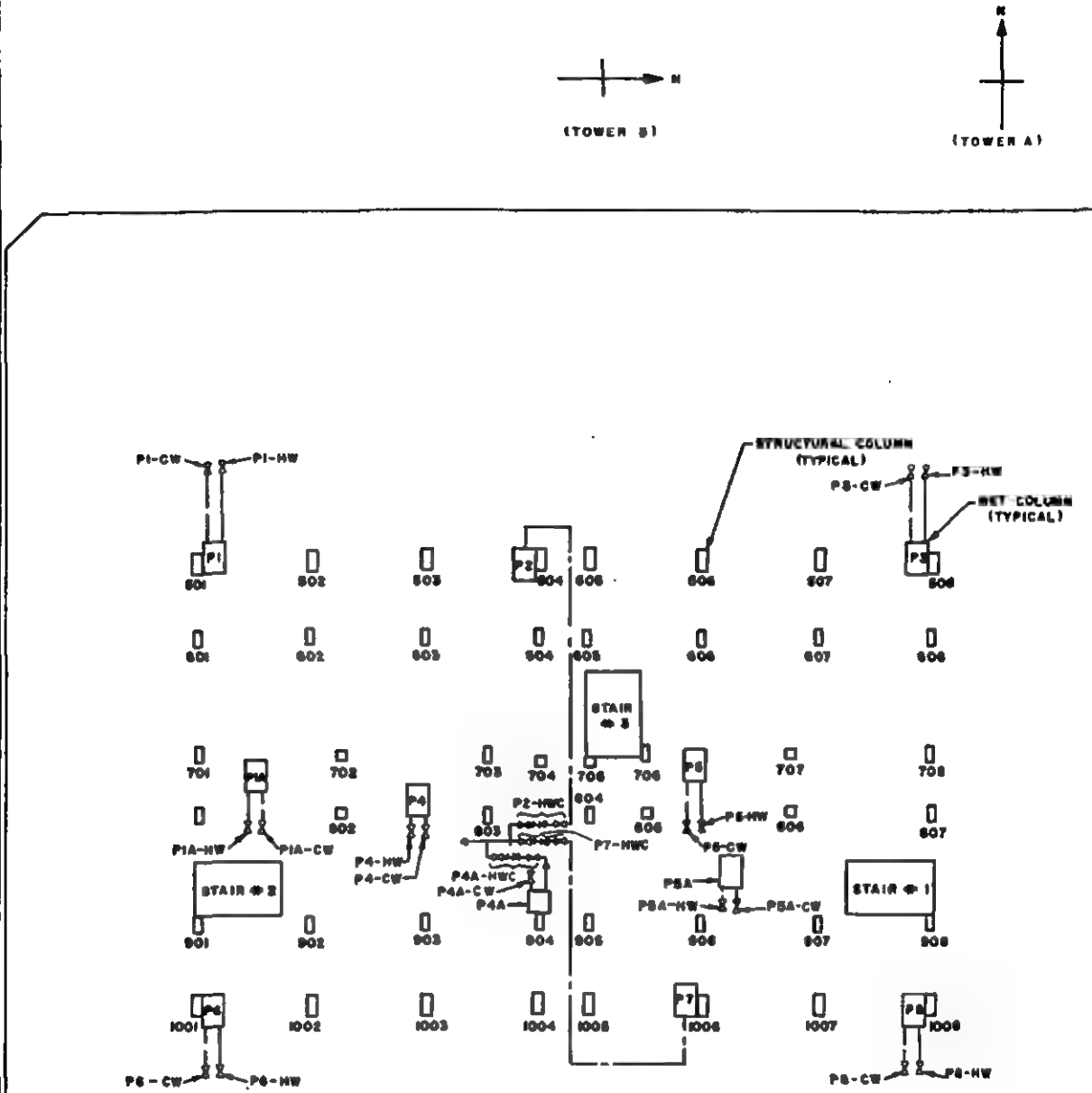


Figure 4-2 **Main Isolation Valves– Zone 1**
Mechanical Equipment Room – Floors 7 & 8

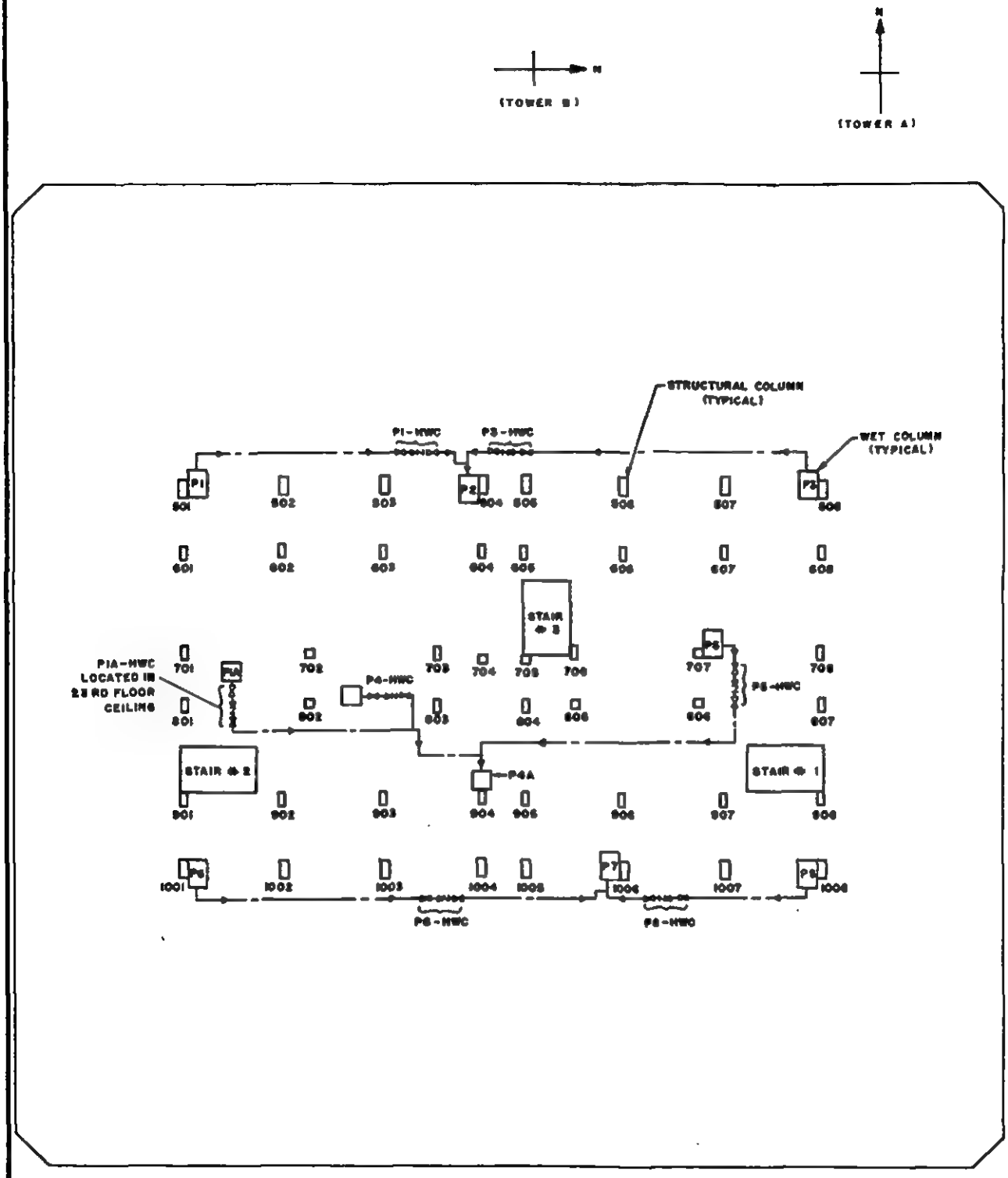


Figure 4-3 **Hot Water Circulation System Valves - Zone I Floor 24**

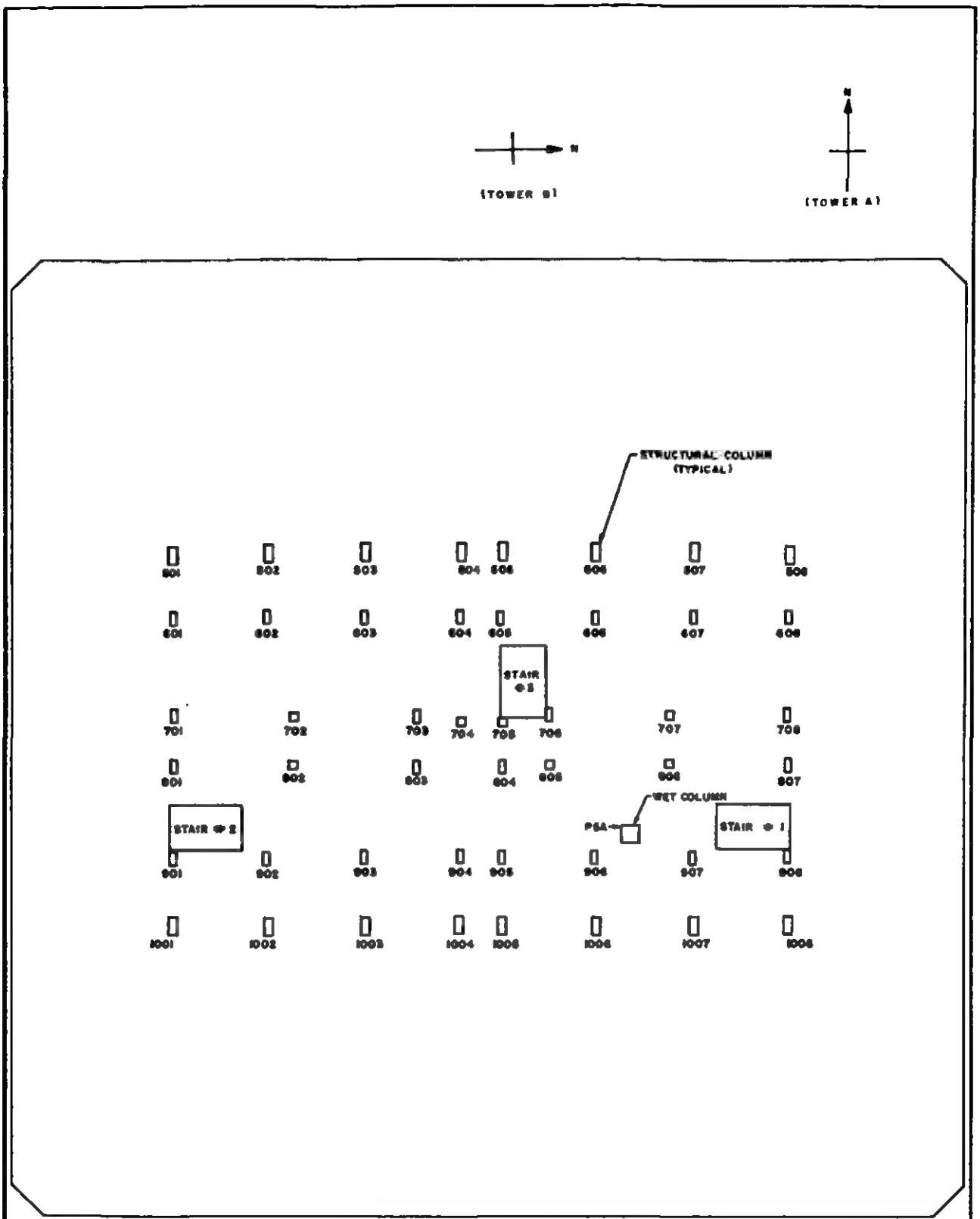


Figure 4-4 Wet Column Locations – Zone I
Floors 2 Thru 6

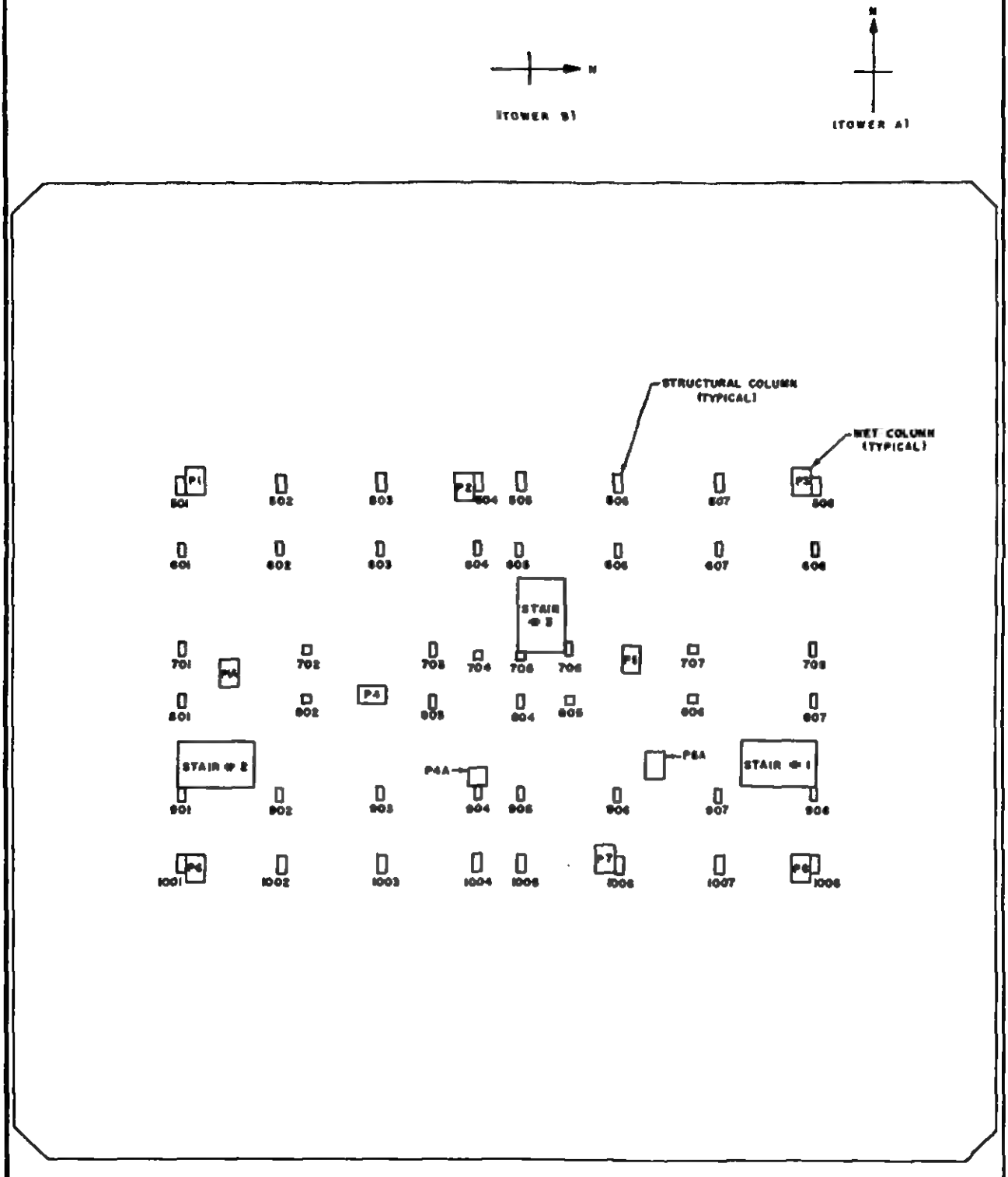


Figure 4-5 Wet Column Locations–Zone 1
Floors 7 Thru 18

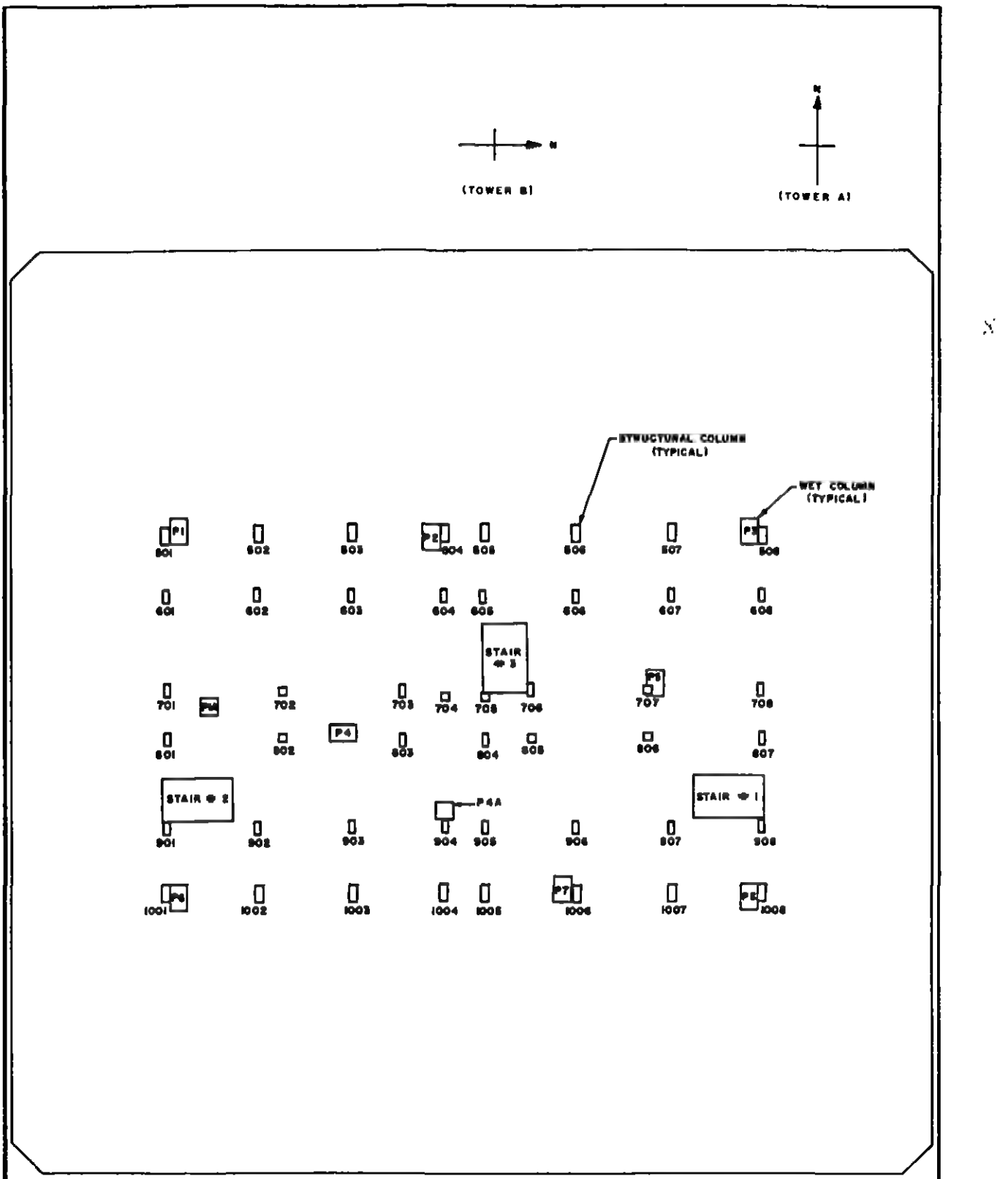


Figure 4-6 Wet Column Locations – Zone I
Floors 19 Thru 24

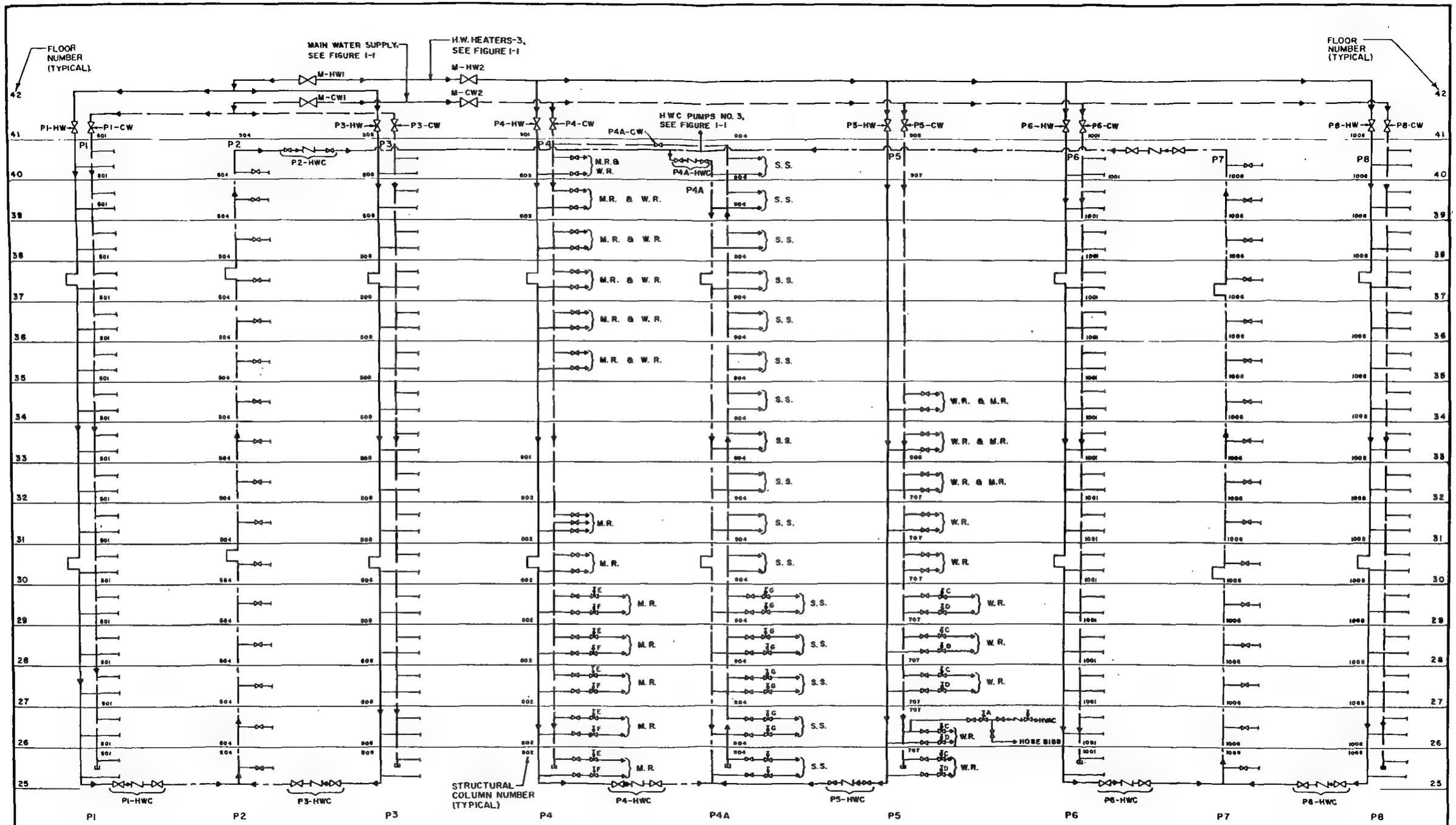


Figure 4-7 **Domestic Water Distribution Diagram — Zone 2**
Floors 25 Thru 40 — Towers A & B

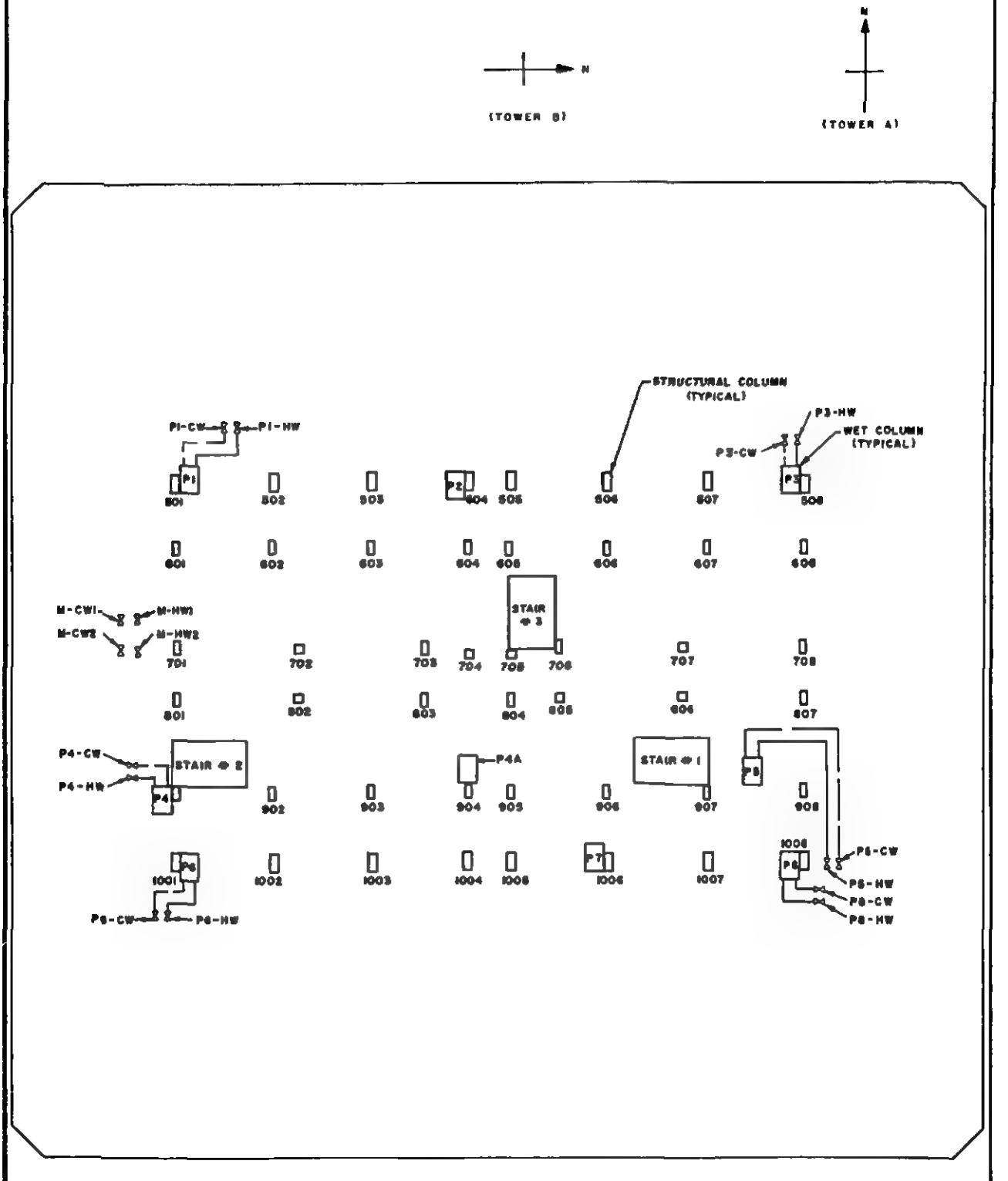


Figure 4-8 Main Isolation Valves — Zone 2
Mechanical Equipment Room — Floor 41

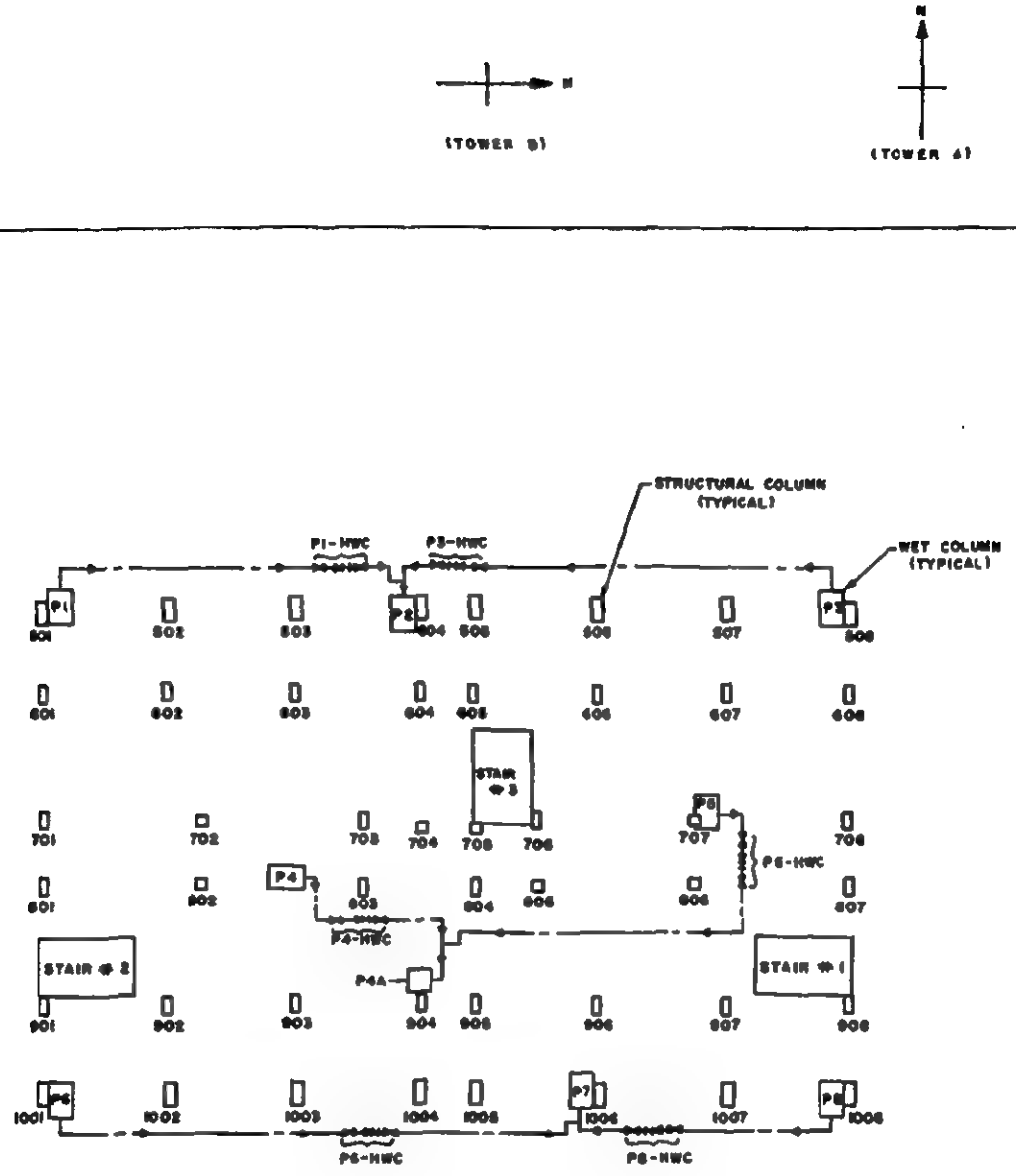


Figure 4-9 **Hot Water Circulation System Valves — Zone 2 Floor 25**

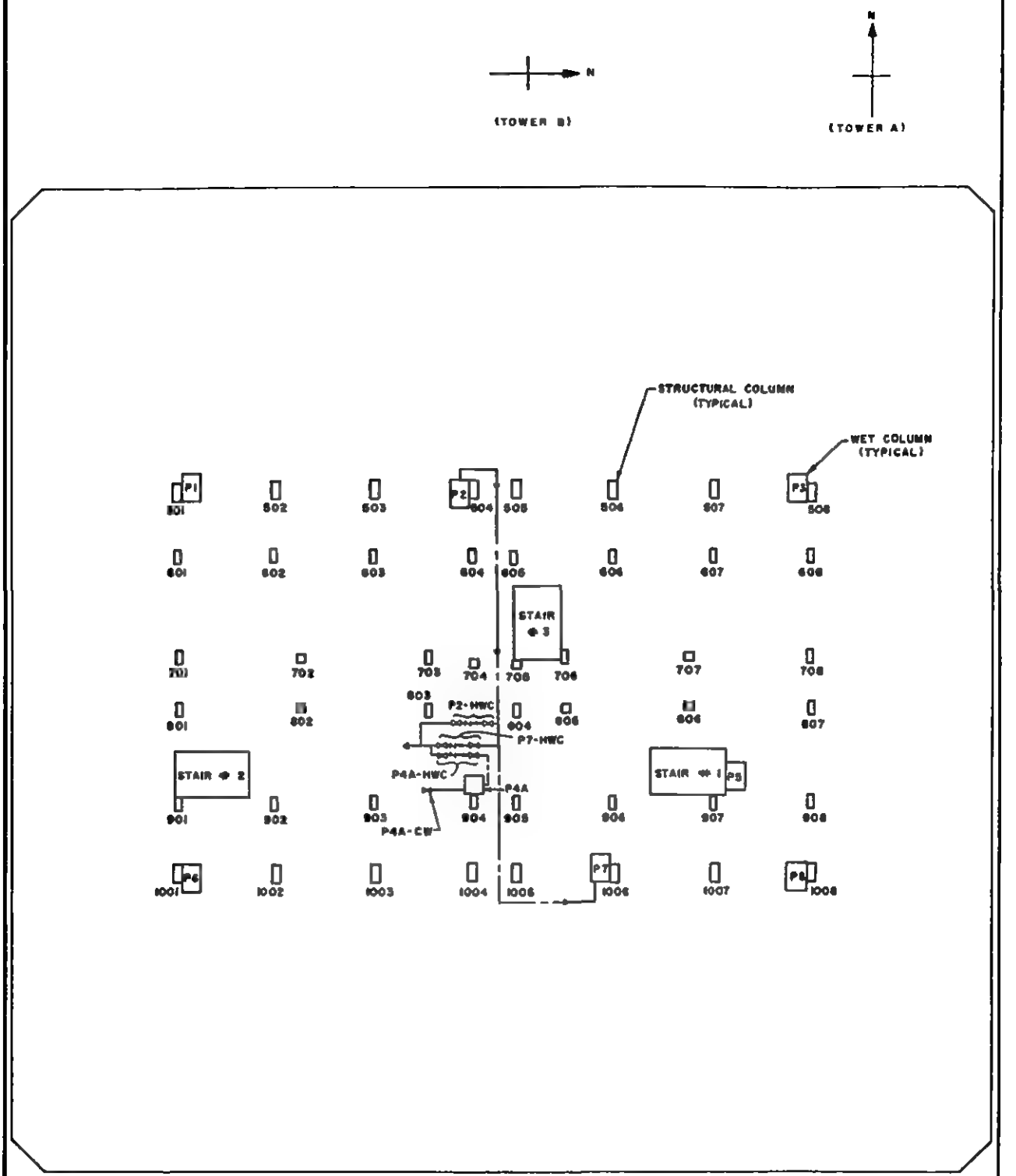


Figure 4-10 Hot Water Circulating System Valves – Zone 2 Floor 40

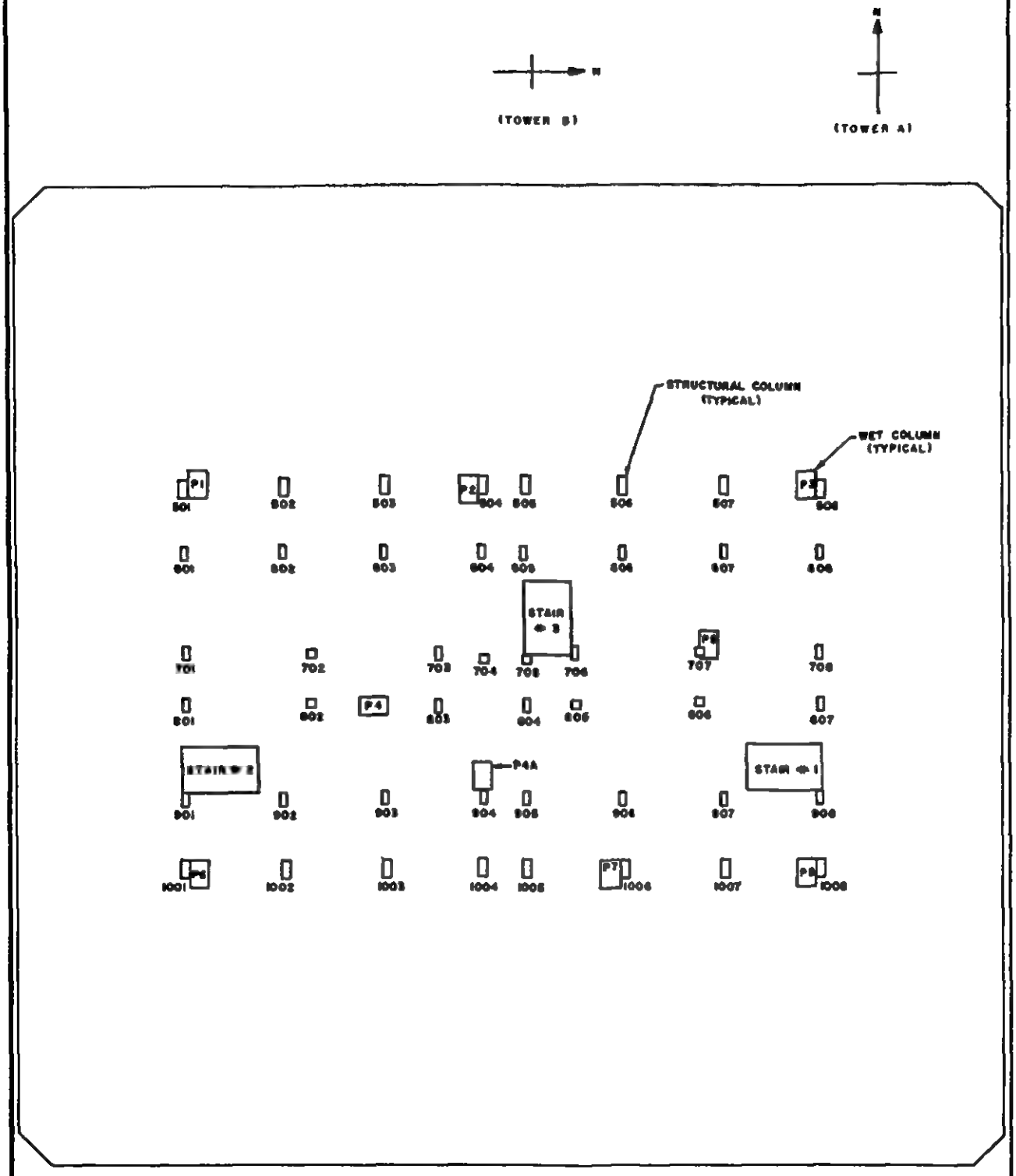


Figure 4-11 Wet Column Locations – Zone 2
Floors 25 Thru 32

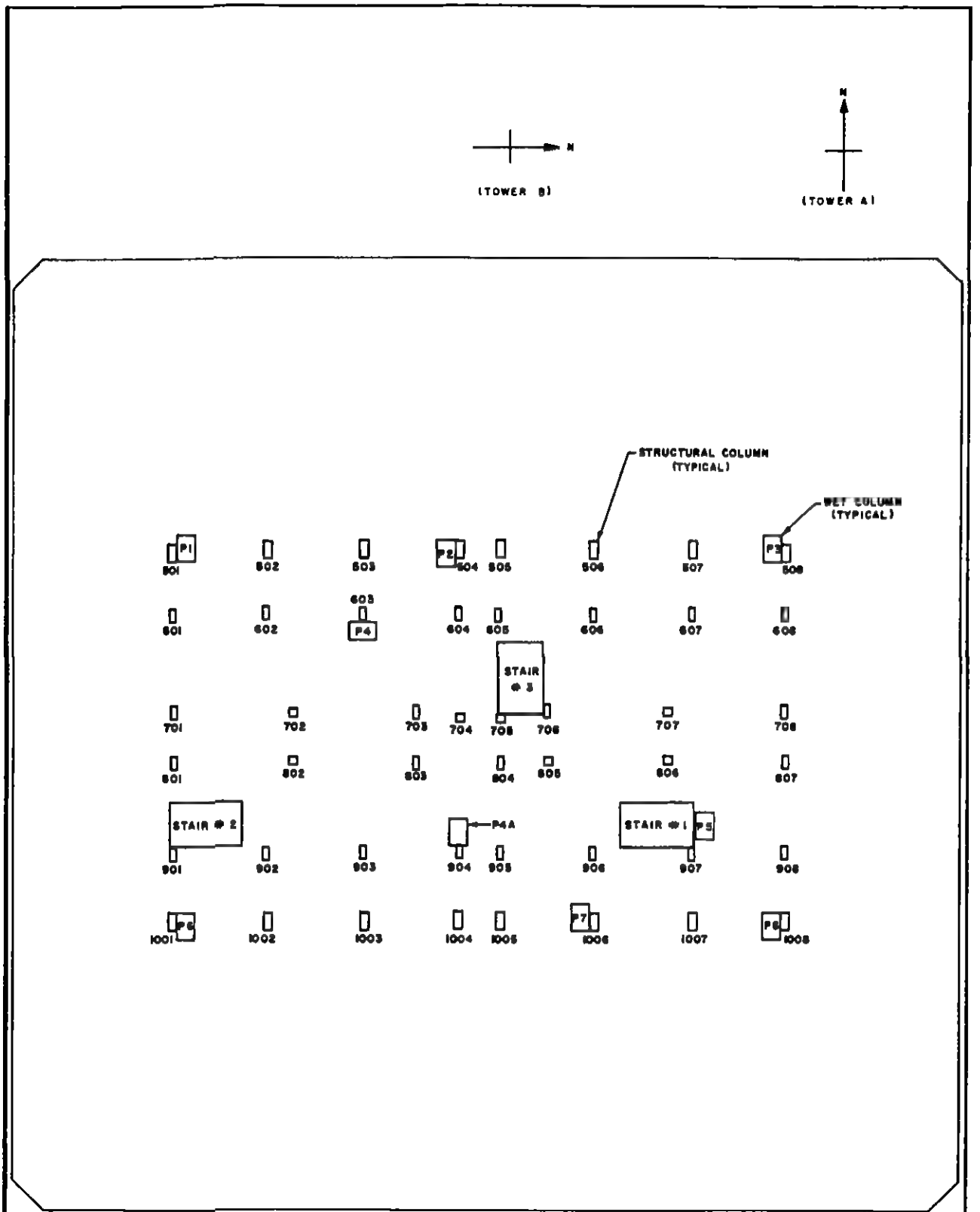


Figure 4-12 Wet Column Locations – Zone 2
Floors 33 Thru 40

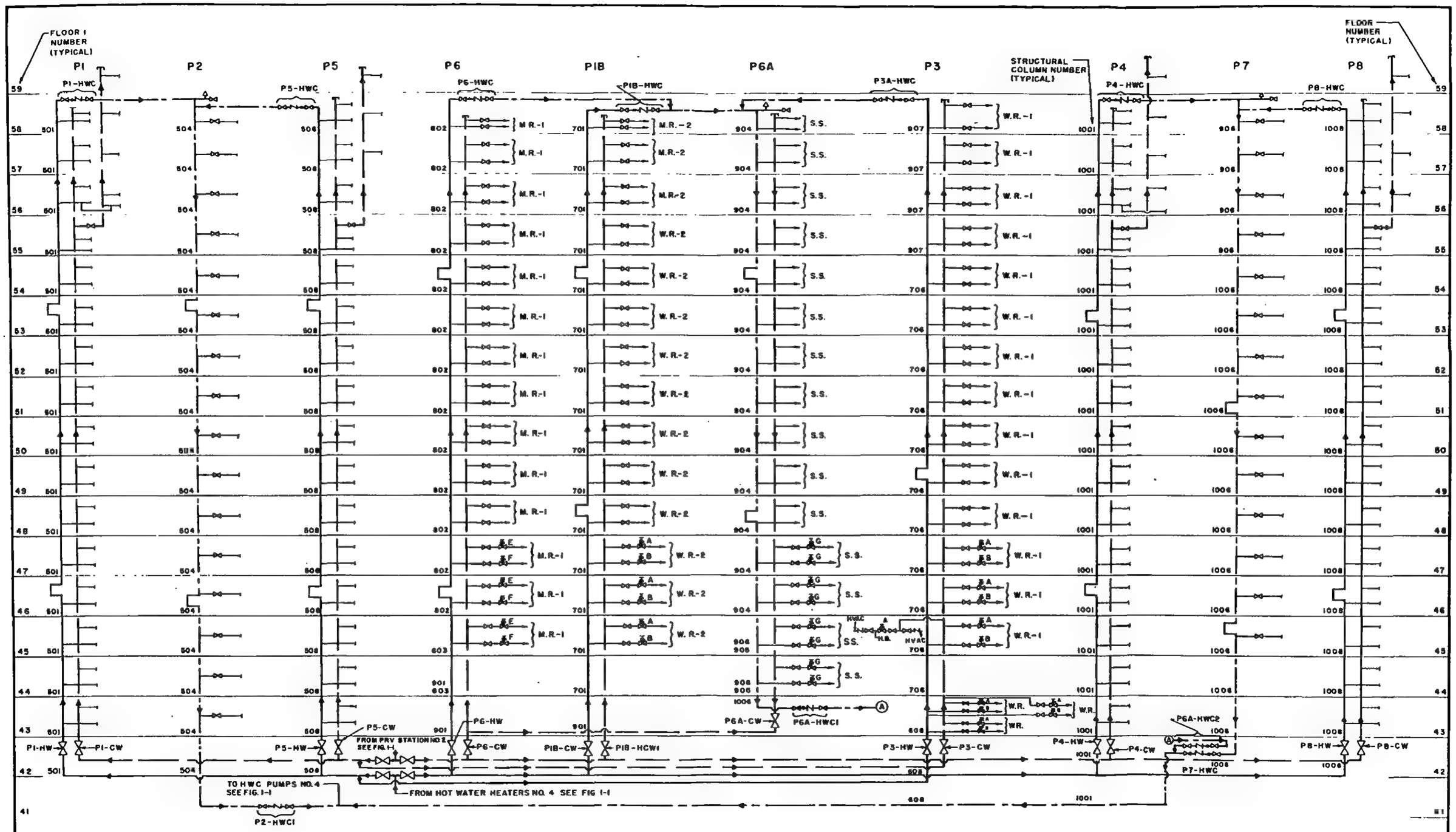


Figure 4-13 Domestic Water Distribution Diagram – Zone 3
Floors 43 Thru 58 — Towers A & B

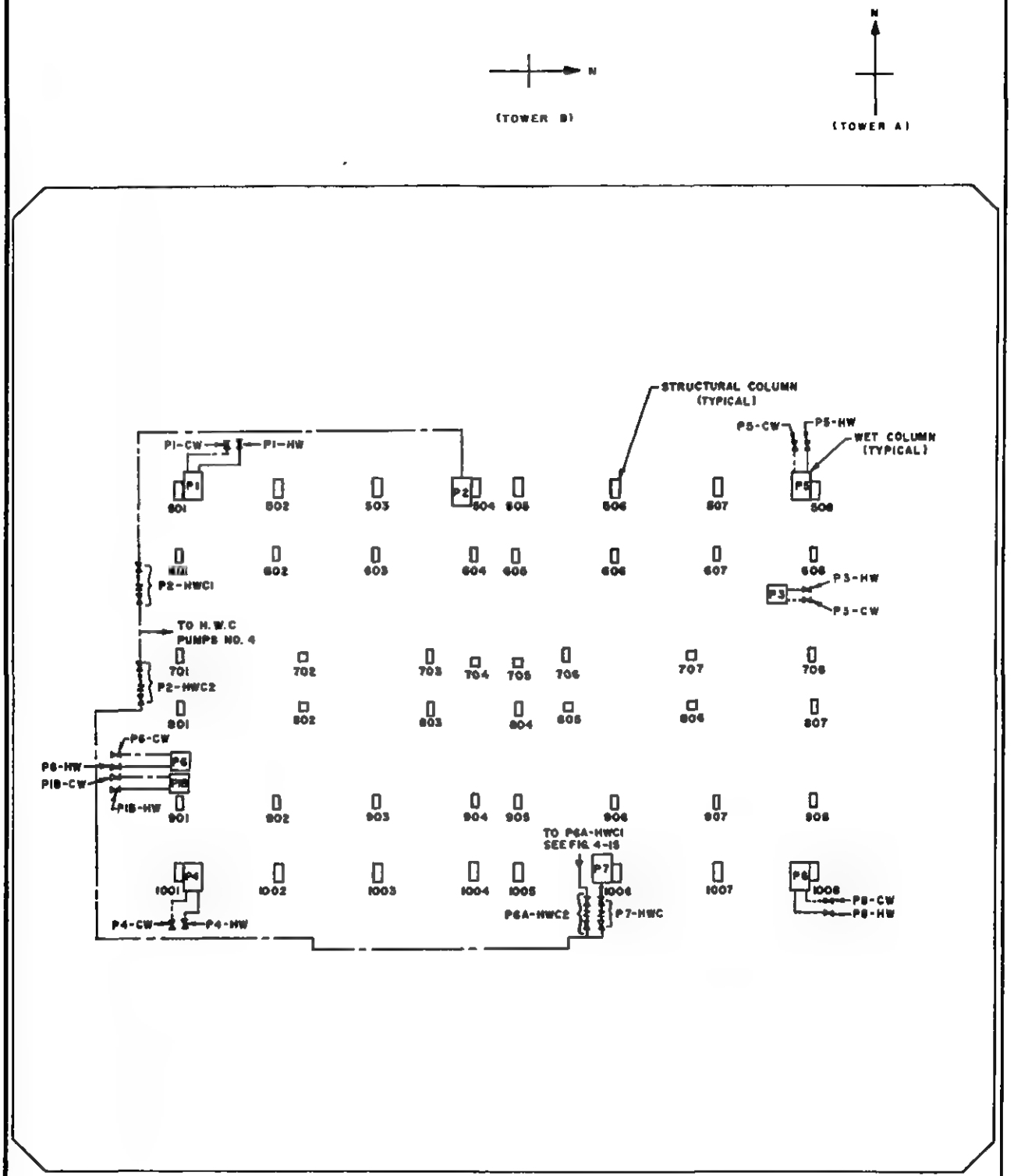


Figure 4-14 Main Isolation Valve Locations — Zone 3
Mechanical Equipment Room — Floors 41 & 42

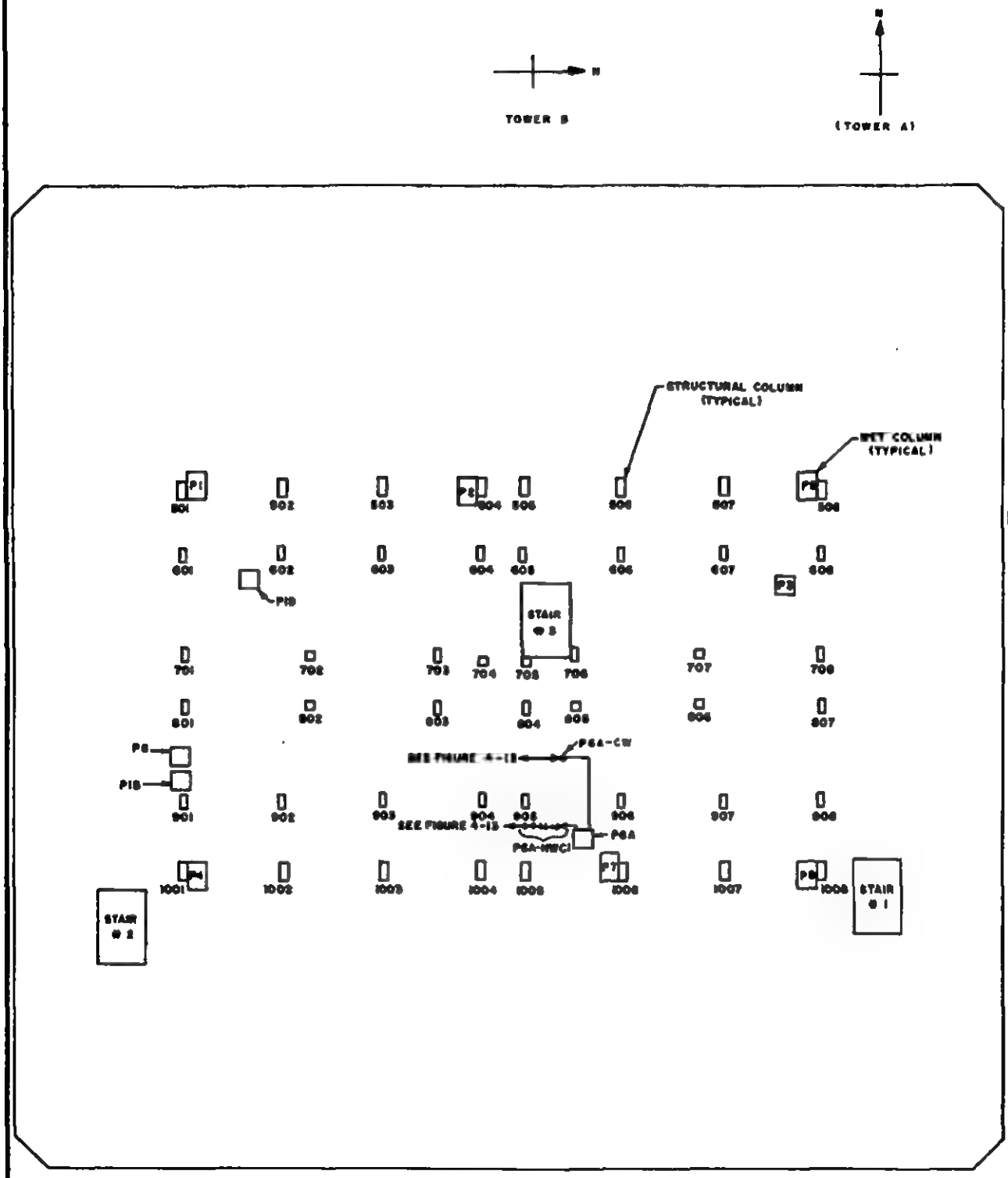


Figure 4-15 Main Isolation & Hot Water Circulation System Valves Zone 3 — Floor 43

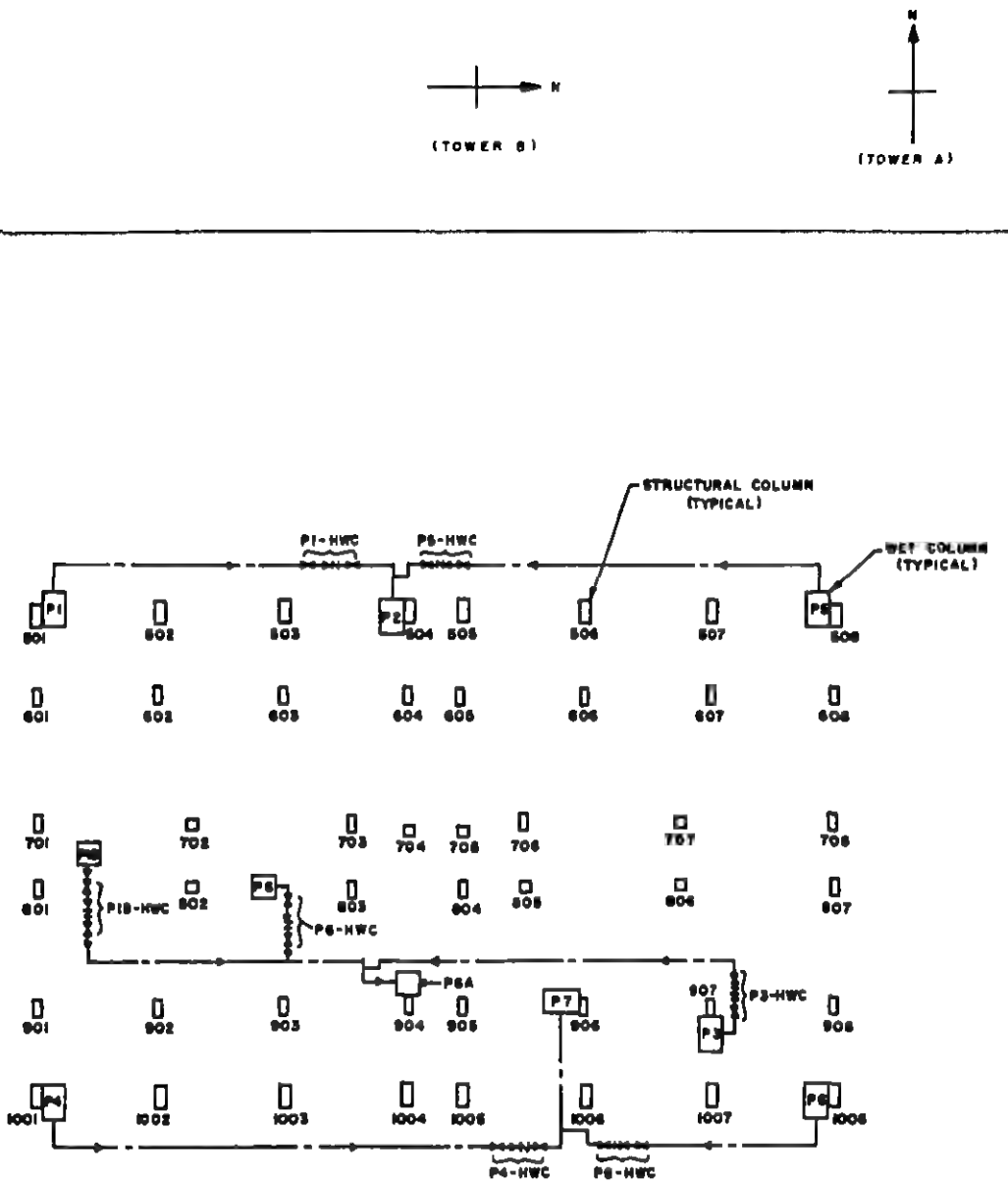


Figure 4-16 Hot Water Circulation System Valves – Zone 3 Floor 58

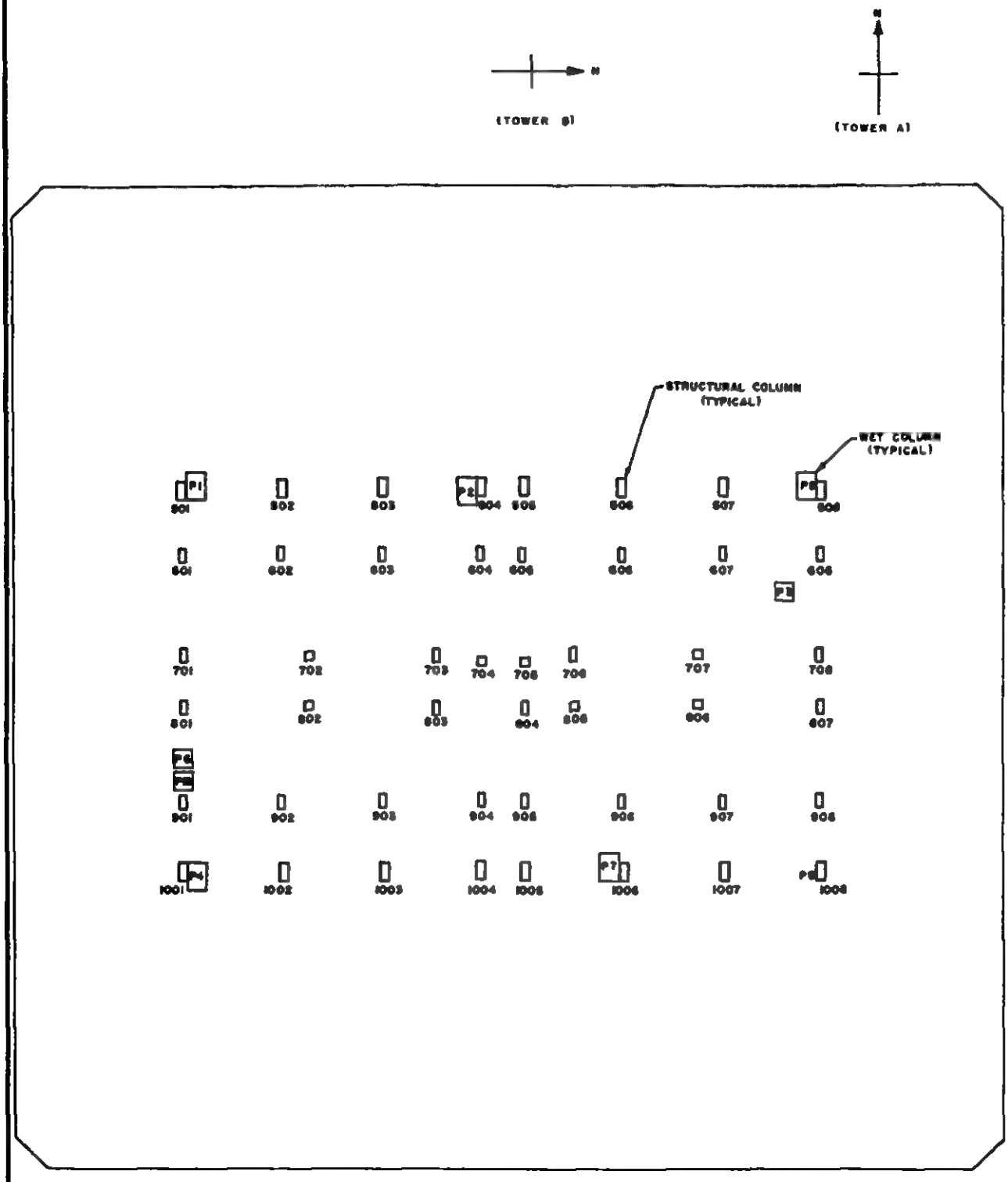


Figure 4-17 Wet Column Locations - Zone 3 Floors 41 and 42

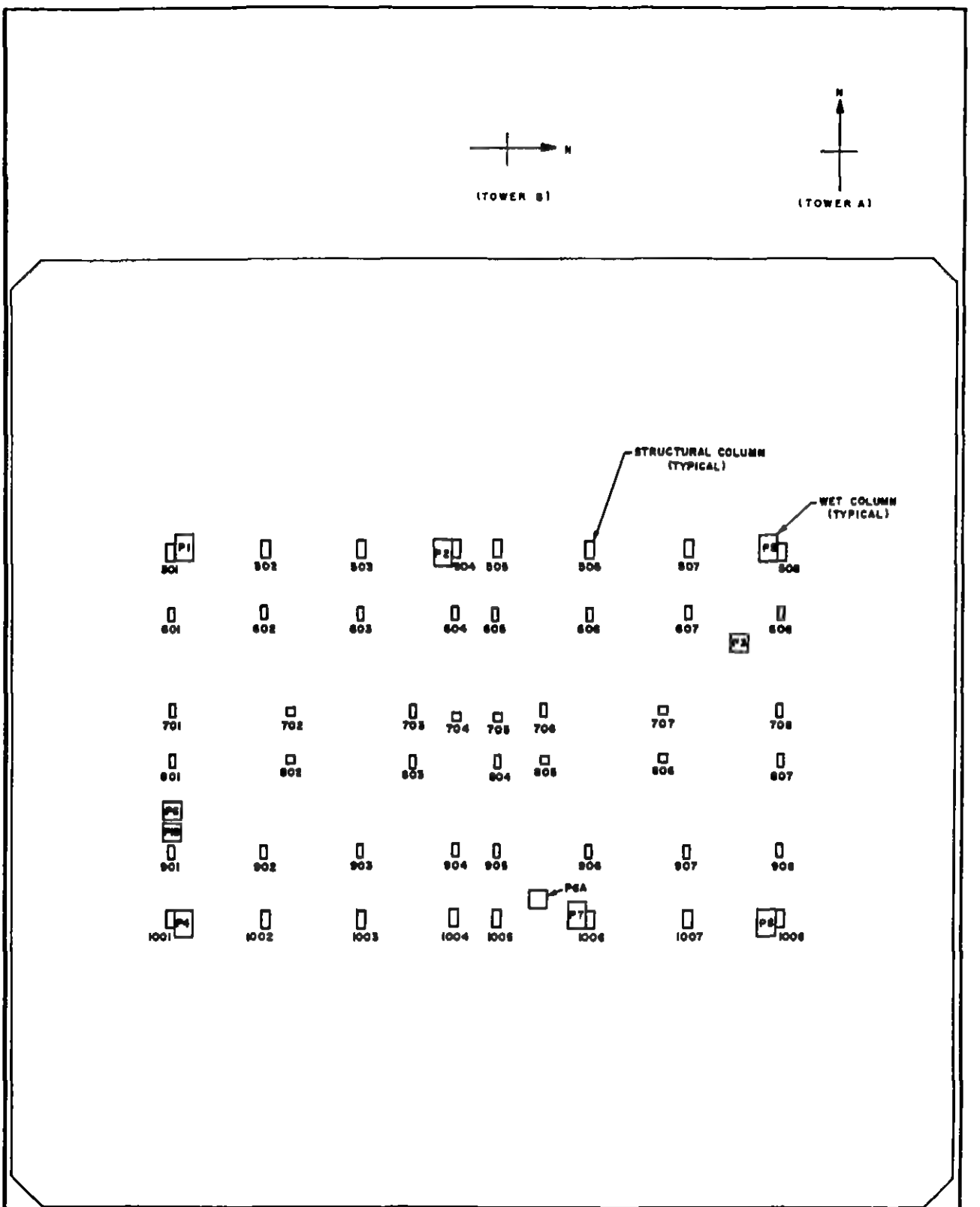


Figure 4-18 Wet Column Locations – Zone 3
Floor 43

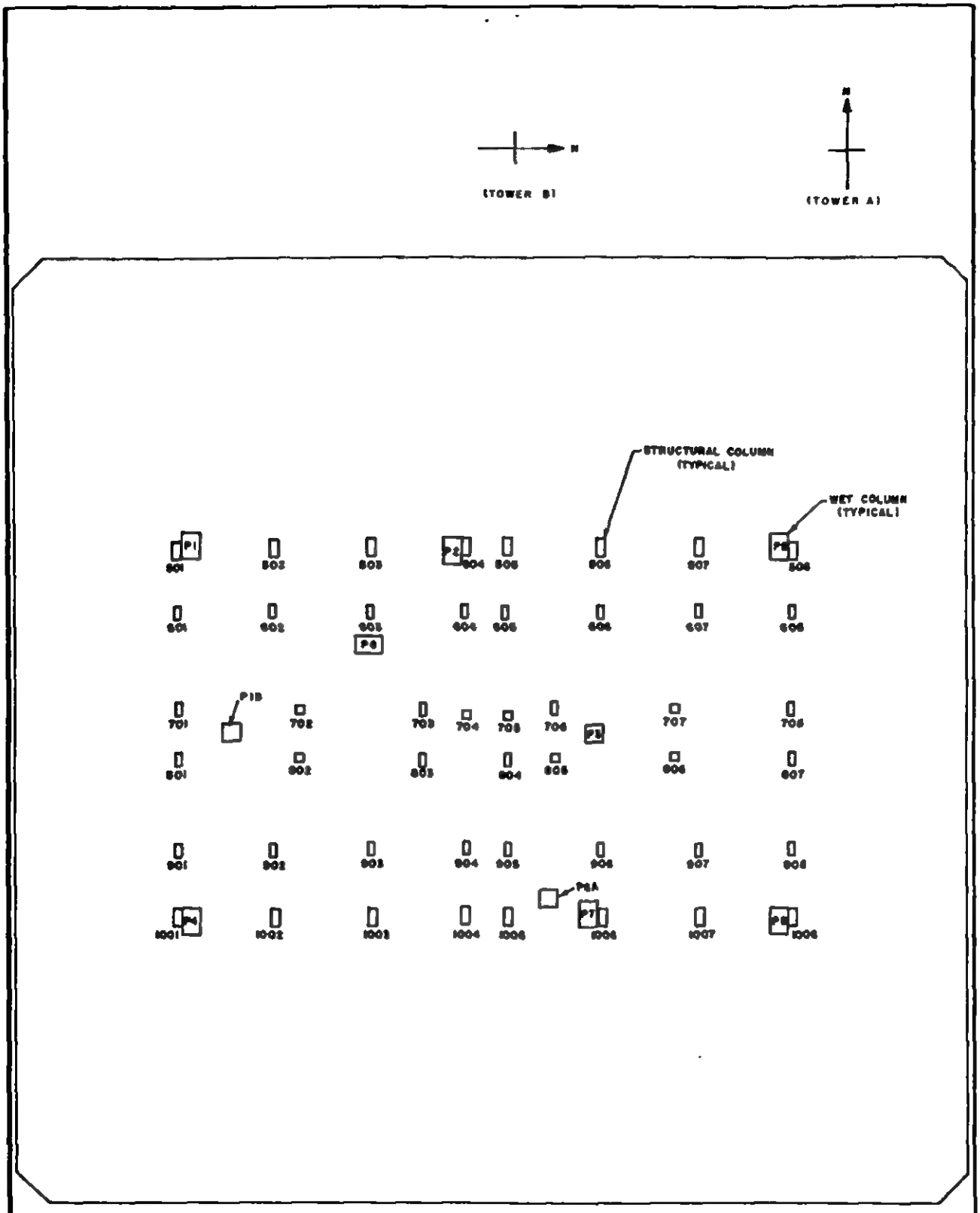


Figure 4-19 Wet Column Locations – Zone 3 Floors 44 and 45

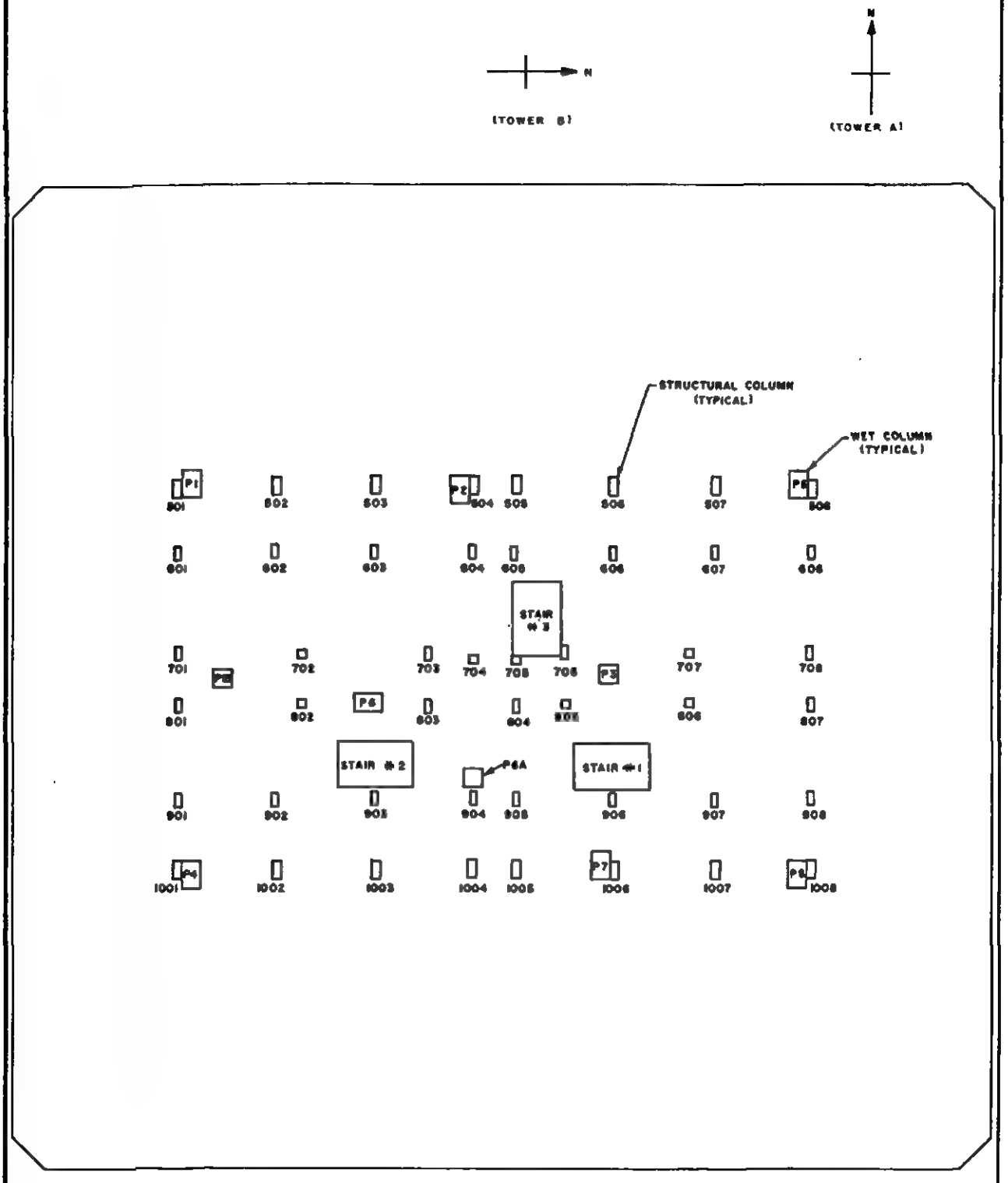


Figure 4-20 Wet Column Locations – Zone 3
Floors 46 Thru 54

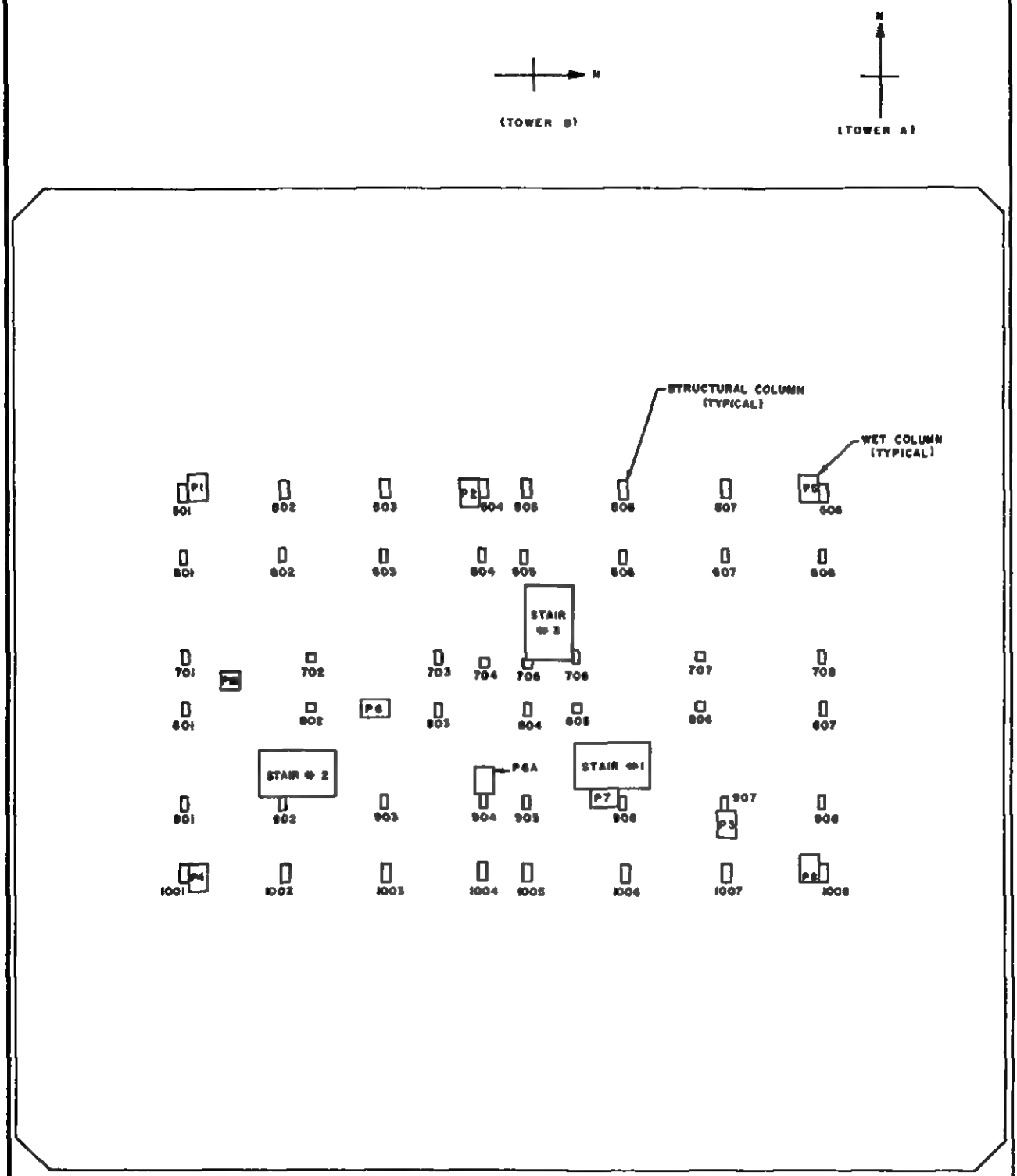


Figure 4-21 Wet Column Locations – Zone 3
Floors 55 Thru 58

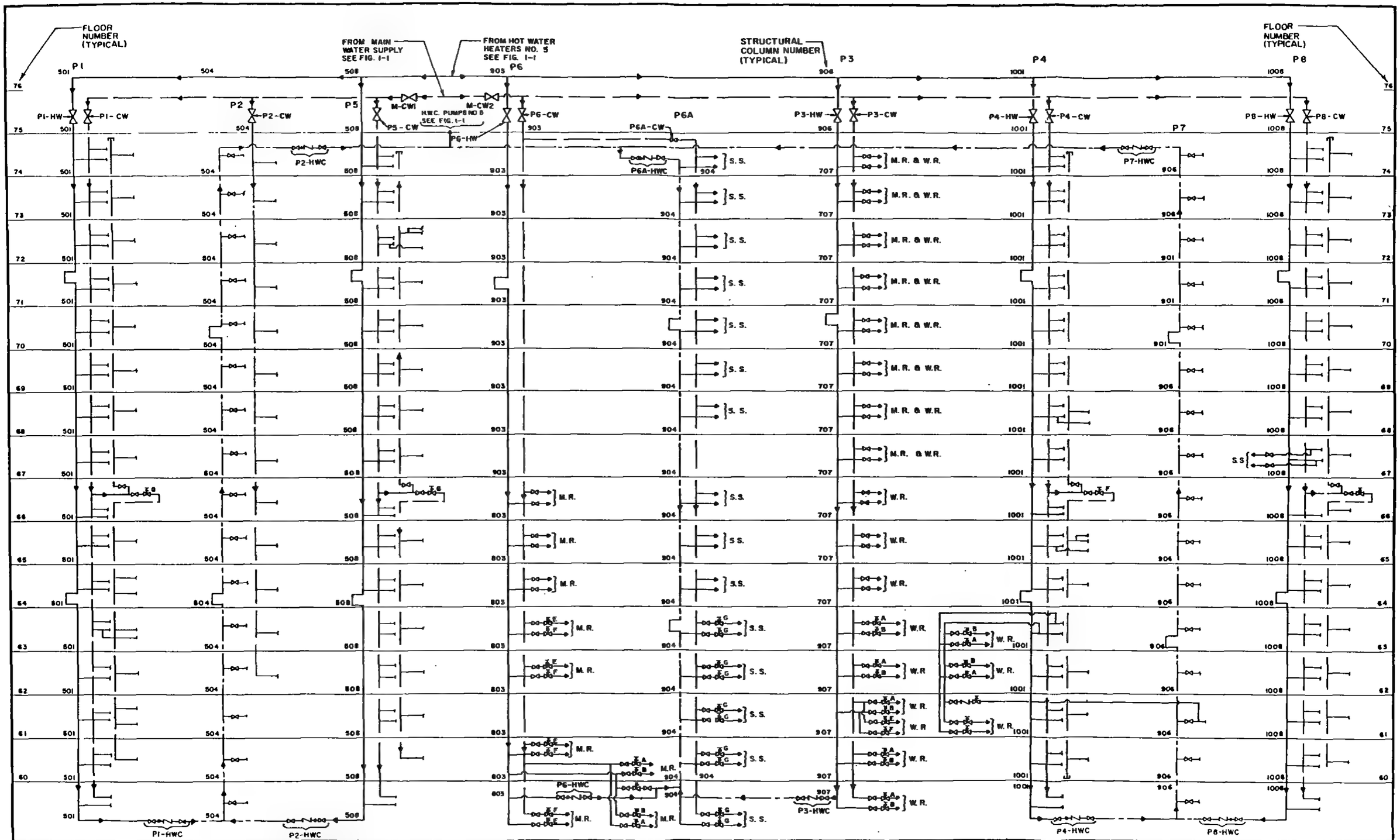


Figure 4-22 Domestic Water Distribution Diagram — Zone 4
Floors 59 Thru 74 — Towers A & B

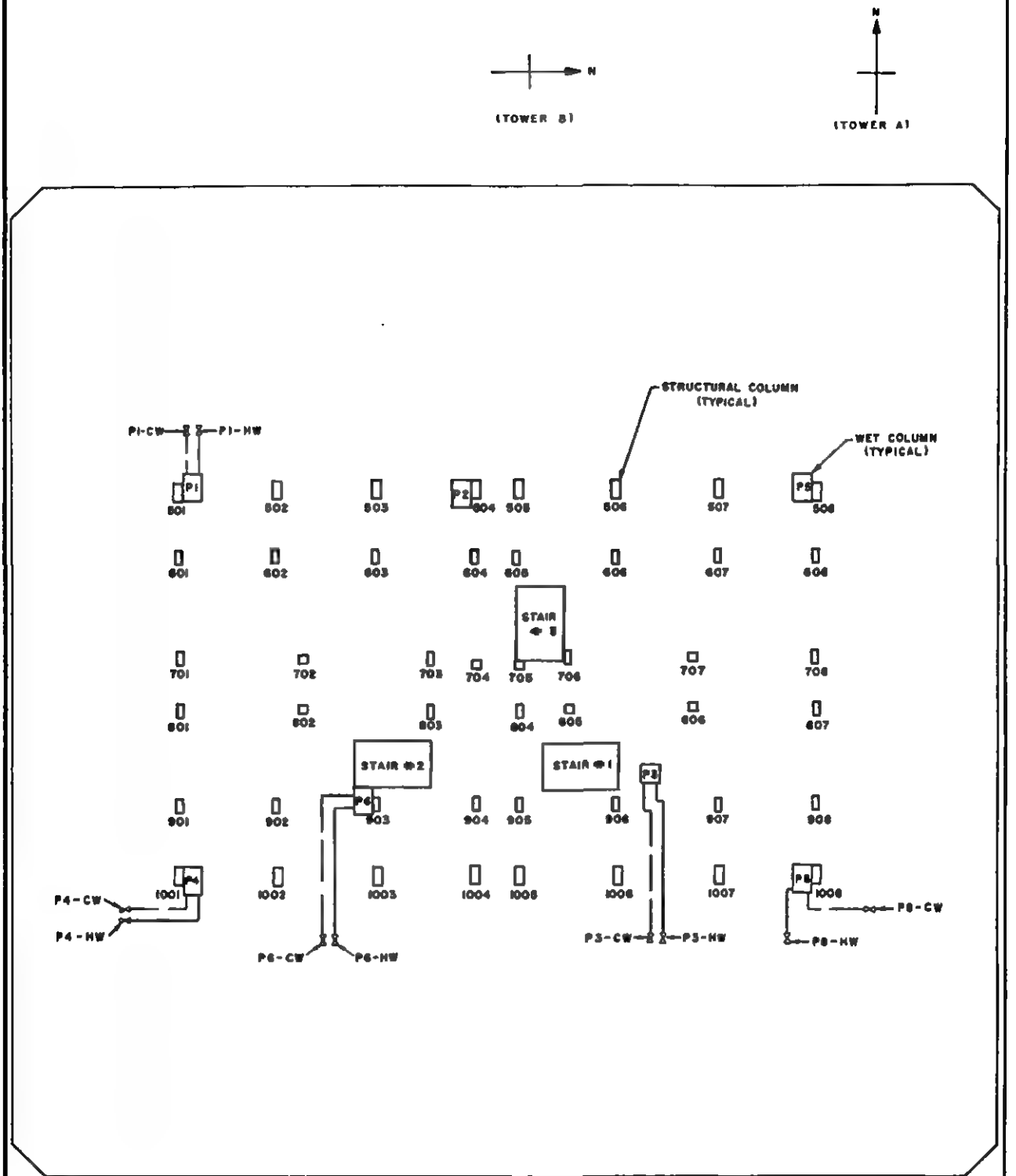


Figure 4-23 Main Isolation Valve Locations — Zone 4
Mechanical Equipment Room – Floors 75 & 76

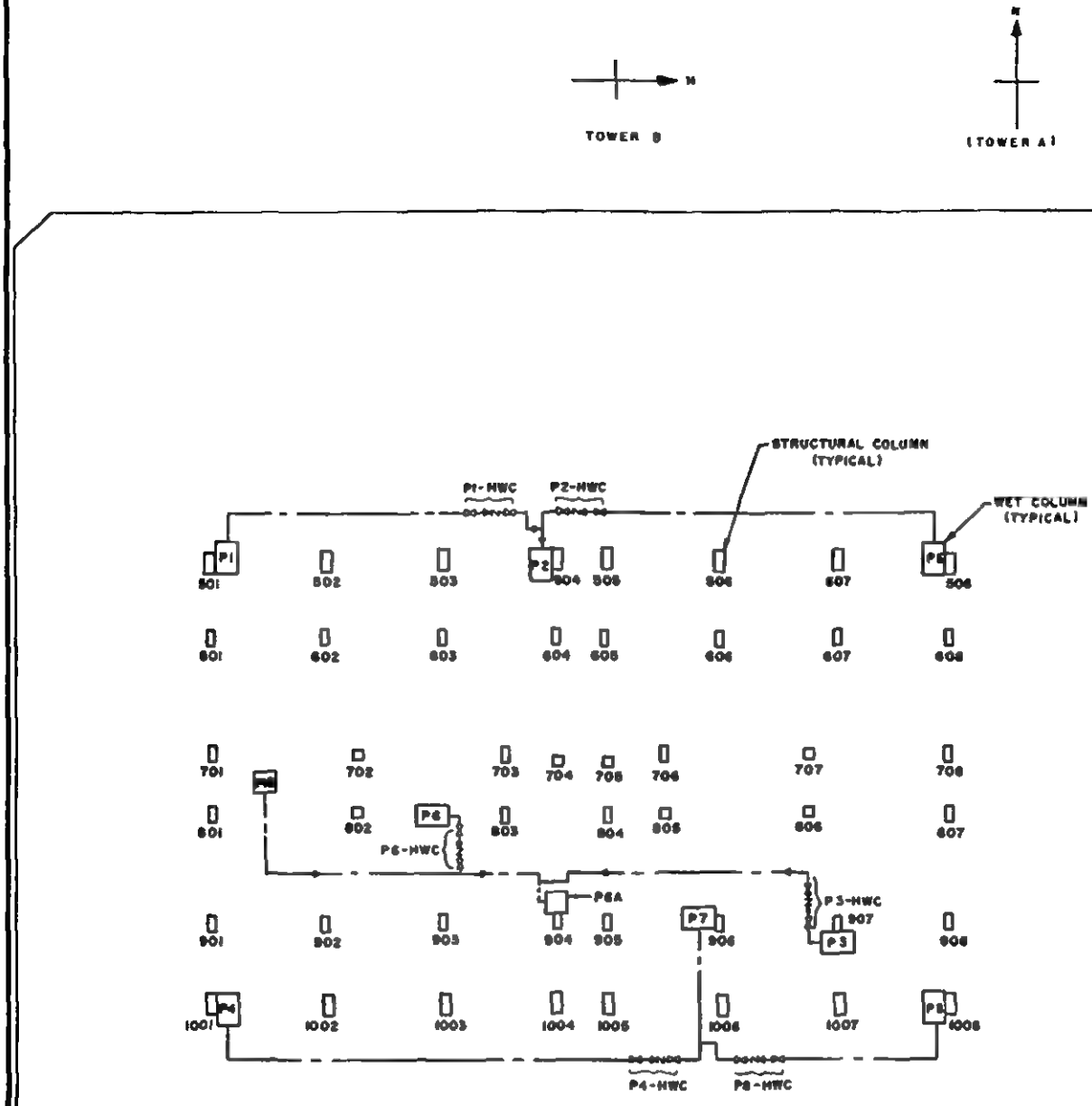


Figure 4-24 **Hot Water Circulation System Valves — Zone 4 Floor 59**

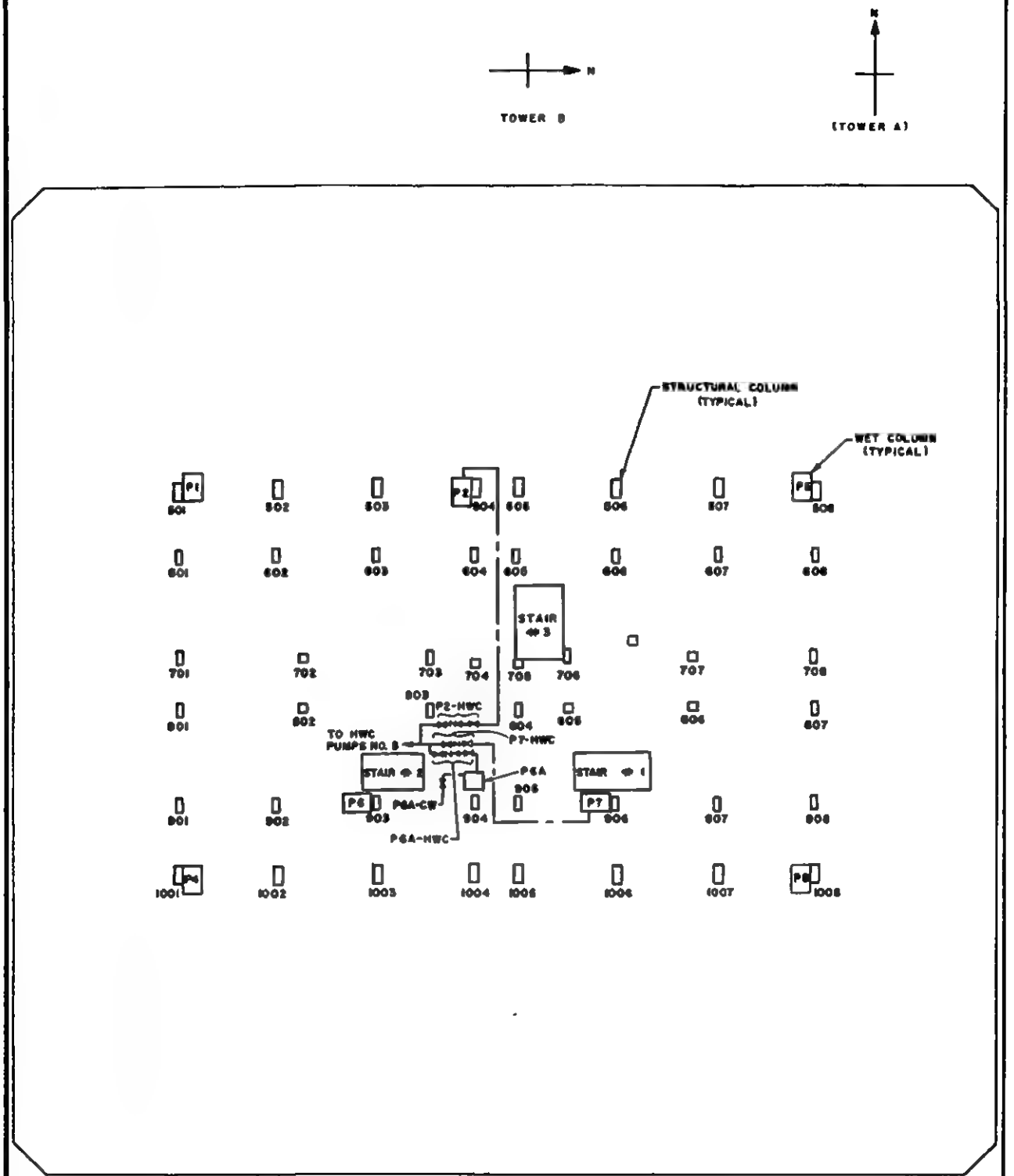


Figure 4-25 **Main Isolation & Hot Water Circulation System Valves – Zone 4 – Floor 74**

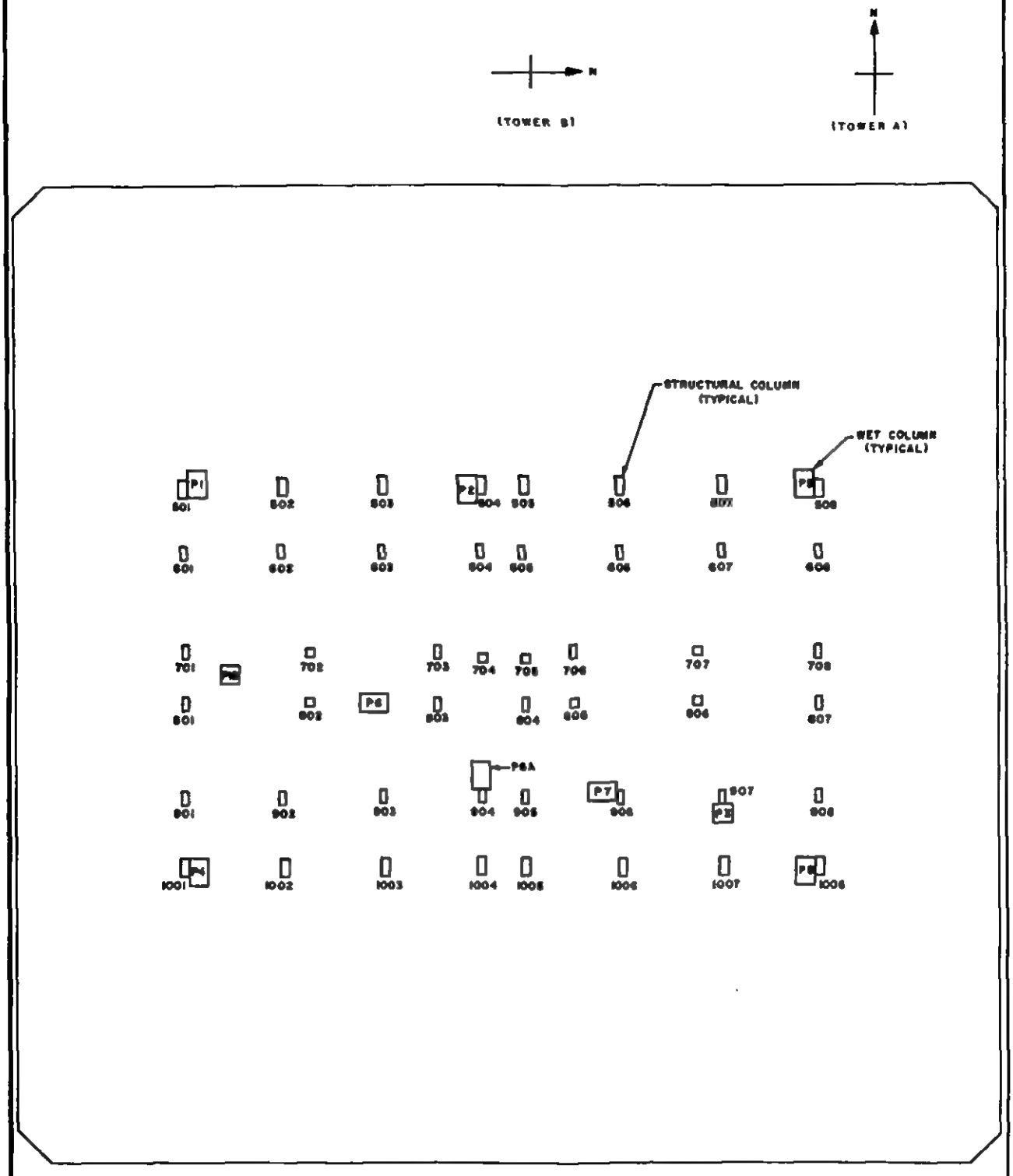


Figure 4-26 Wet Column Locations– Zone 4
Floors 59,60 and 61

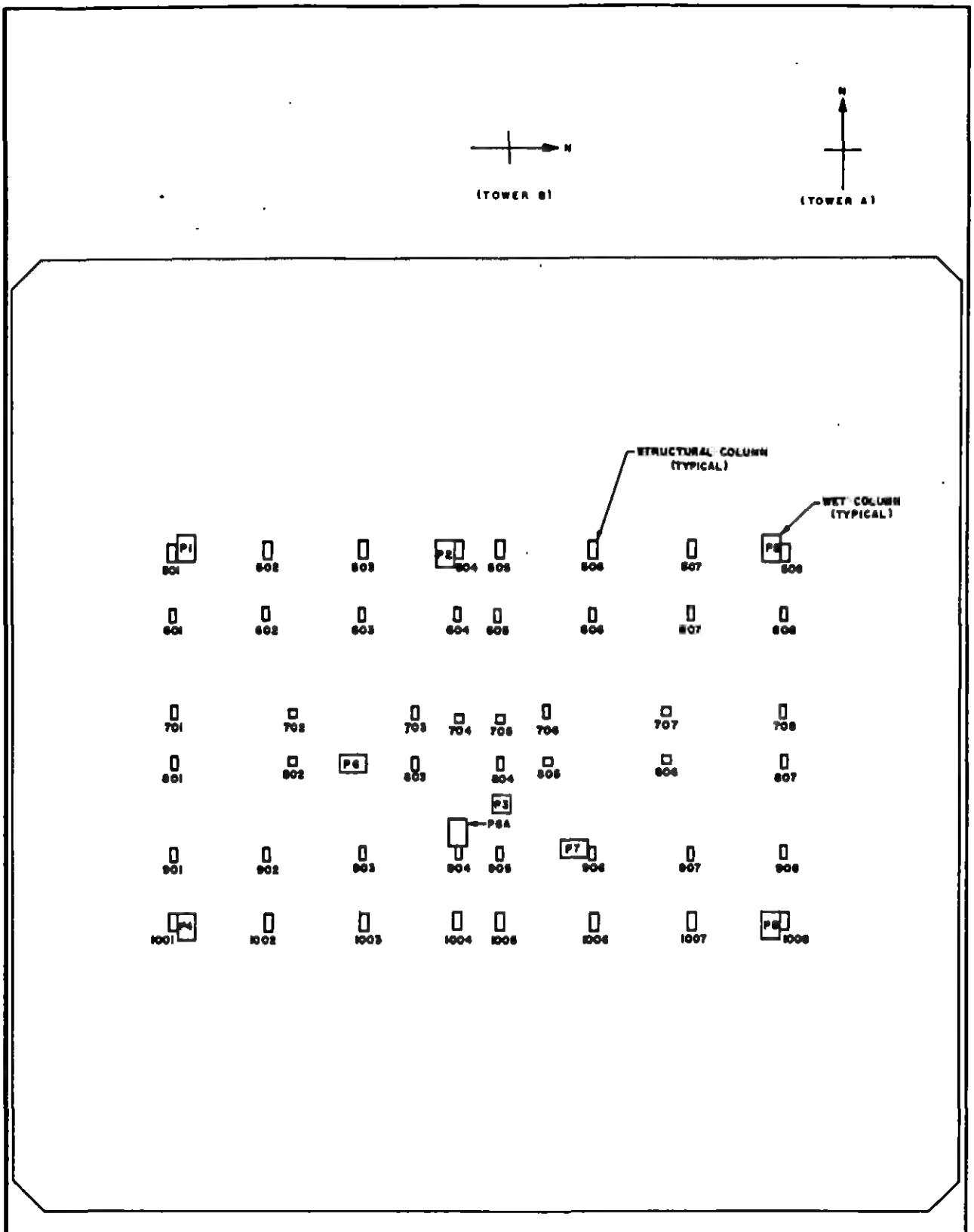


Figure 4-27 Wet Column Locations – Zone 4
Floors 62 and 63

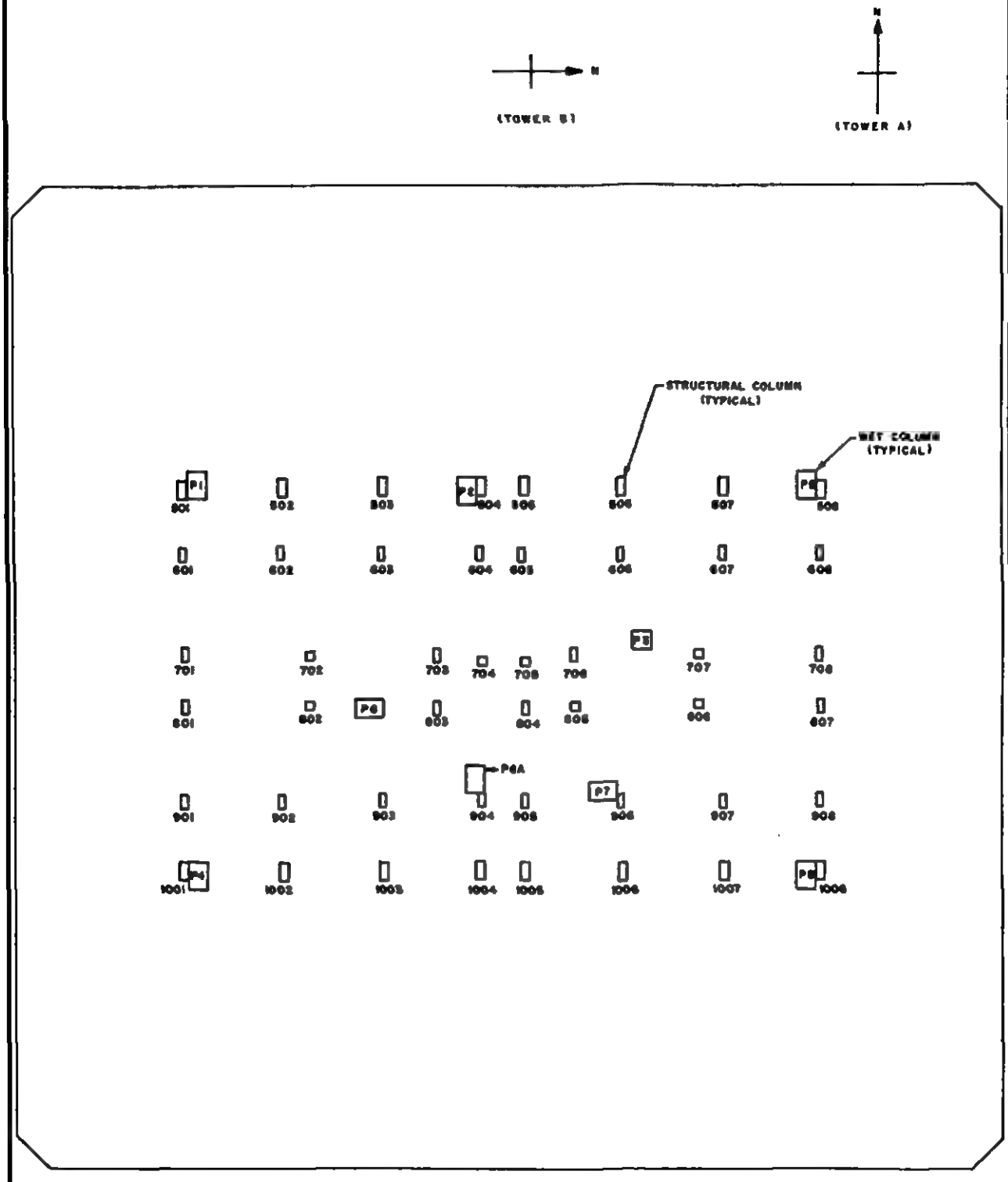


Figure 4-28 Wet Column Locations – Zone 4
Floors 64, 65 and 66

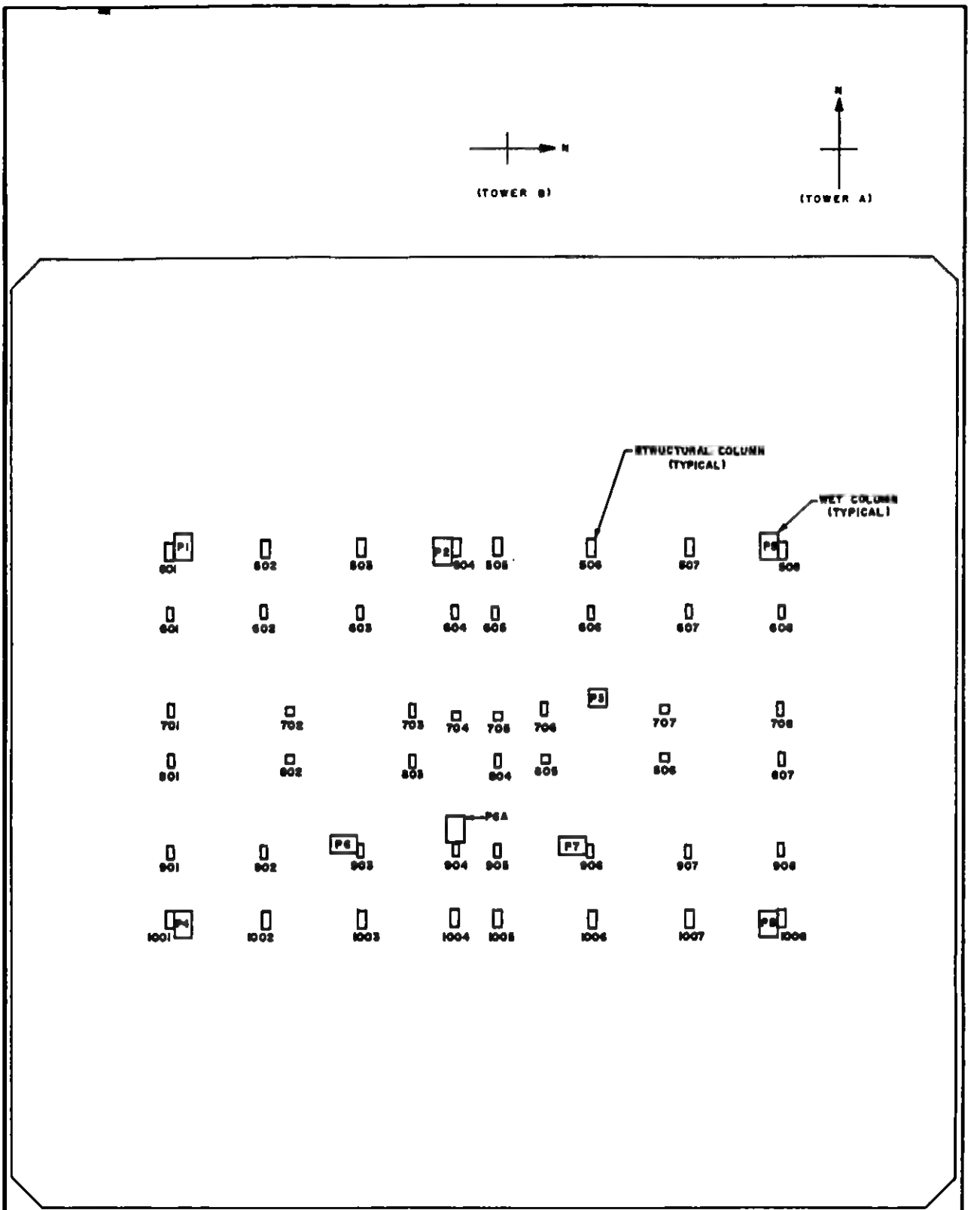


Figure 4-29 Wet Column Locations – Zone 4
Floors 67 Thru 74

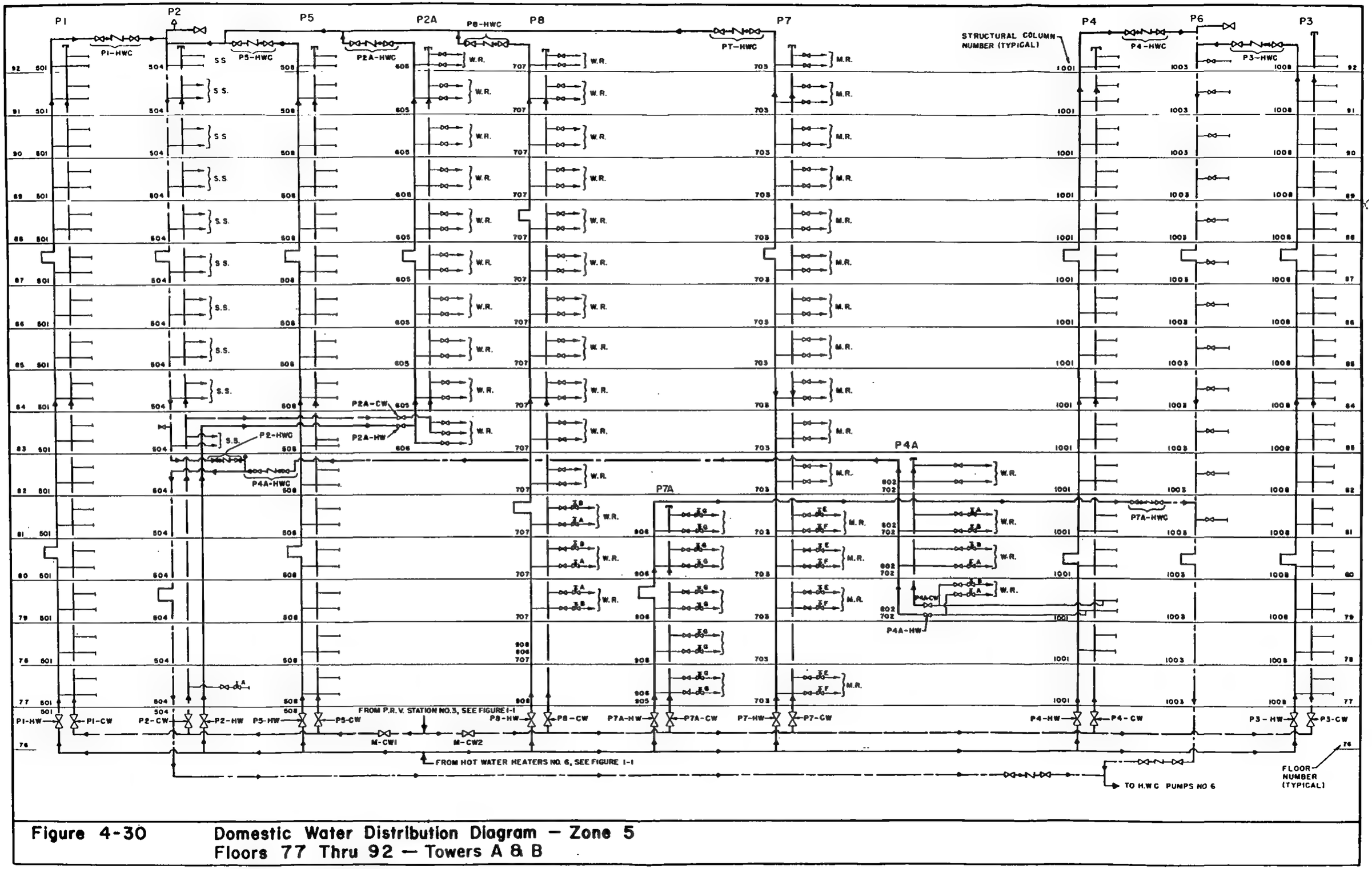


Figure 4-30 Domestic Water Distribution Diagram — Zone 5
Floors 77 Thru 92 — Towers A & B

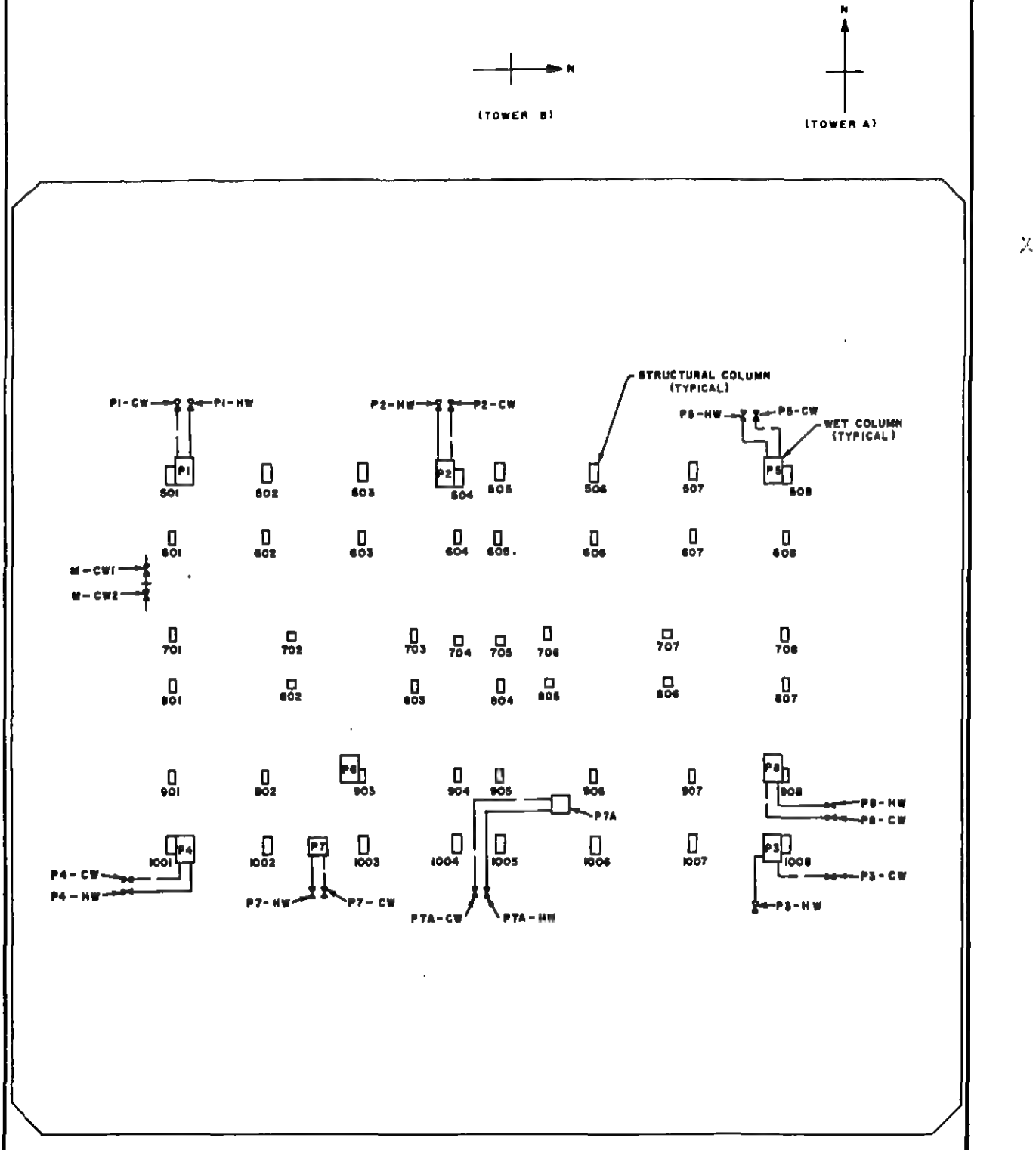


Figure 4-31 Main Isolation Valve Locations – Zone 5
Mechanical Equipment Room - Floors 75 & 76

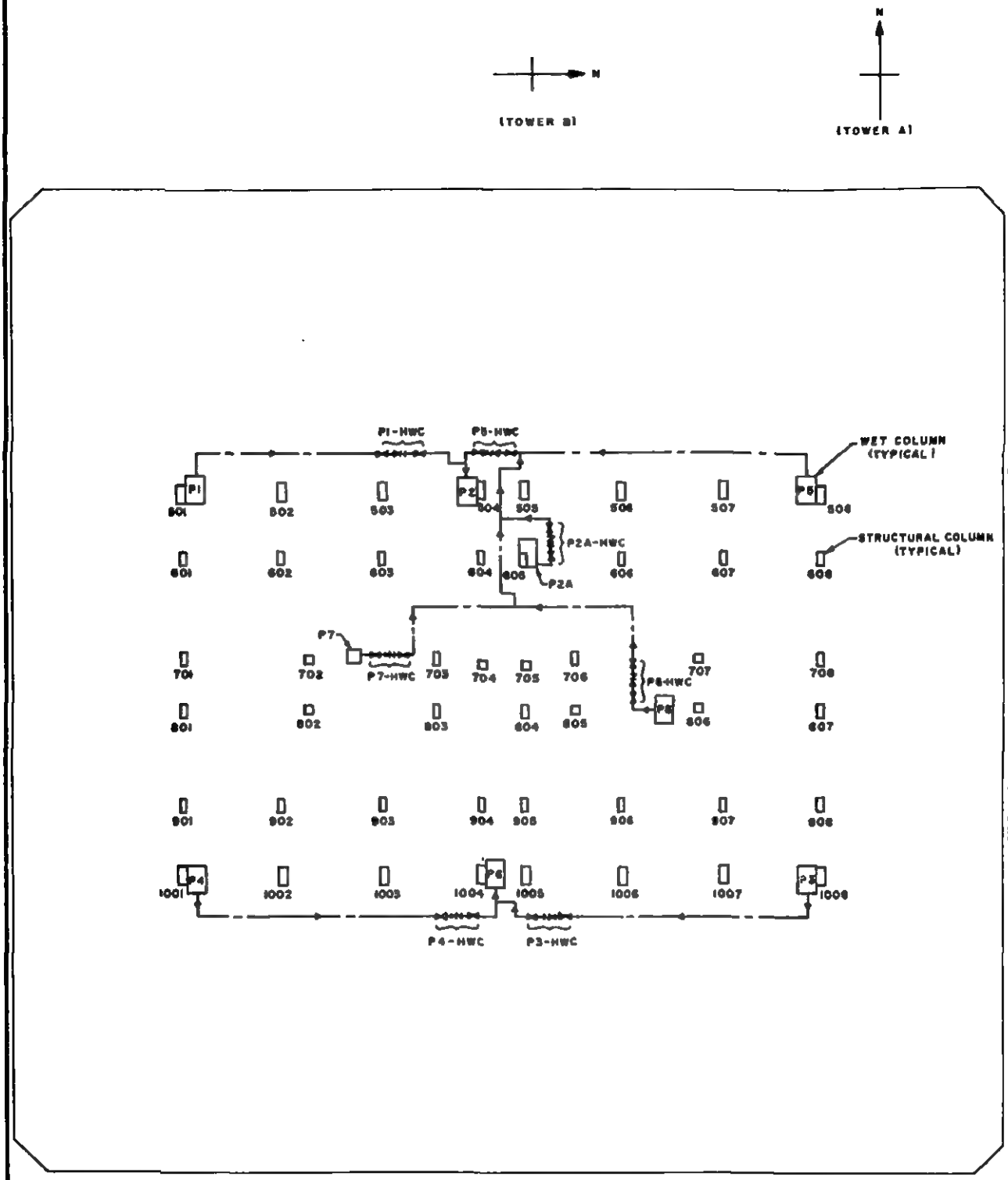


Figure 4-32 Hot Water Circulation System Valves–Zone 5 Floor 92

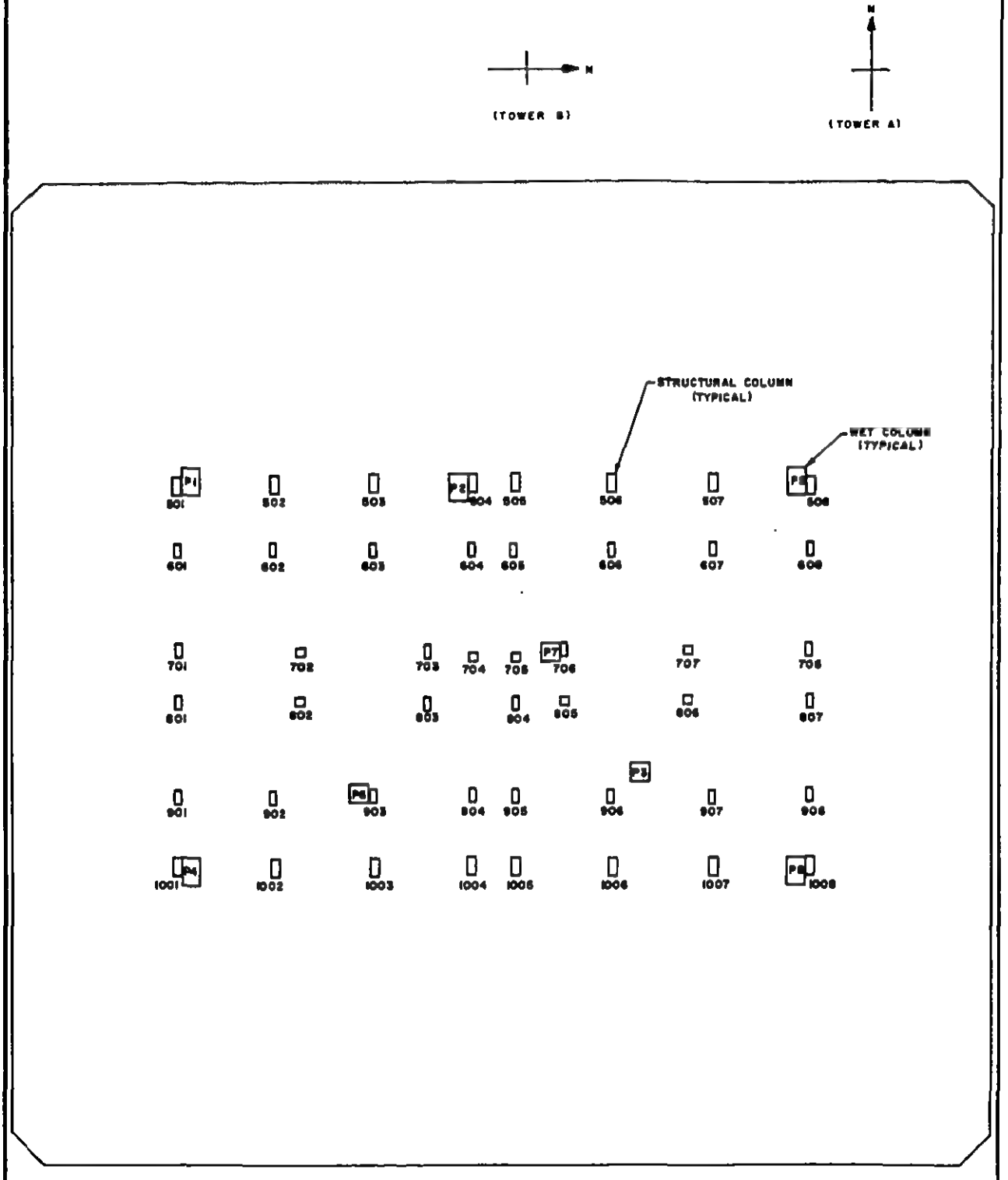


Figure 4-33 Wet Column Locations – Zone 5 Floor 75

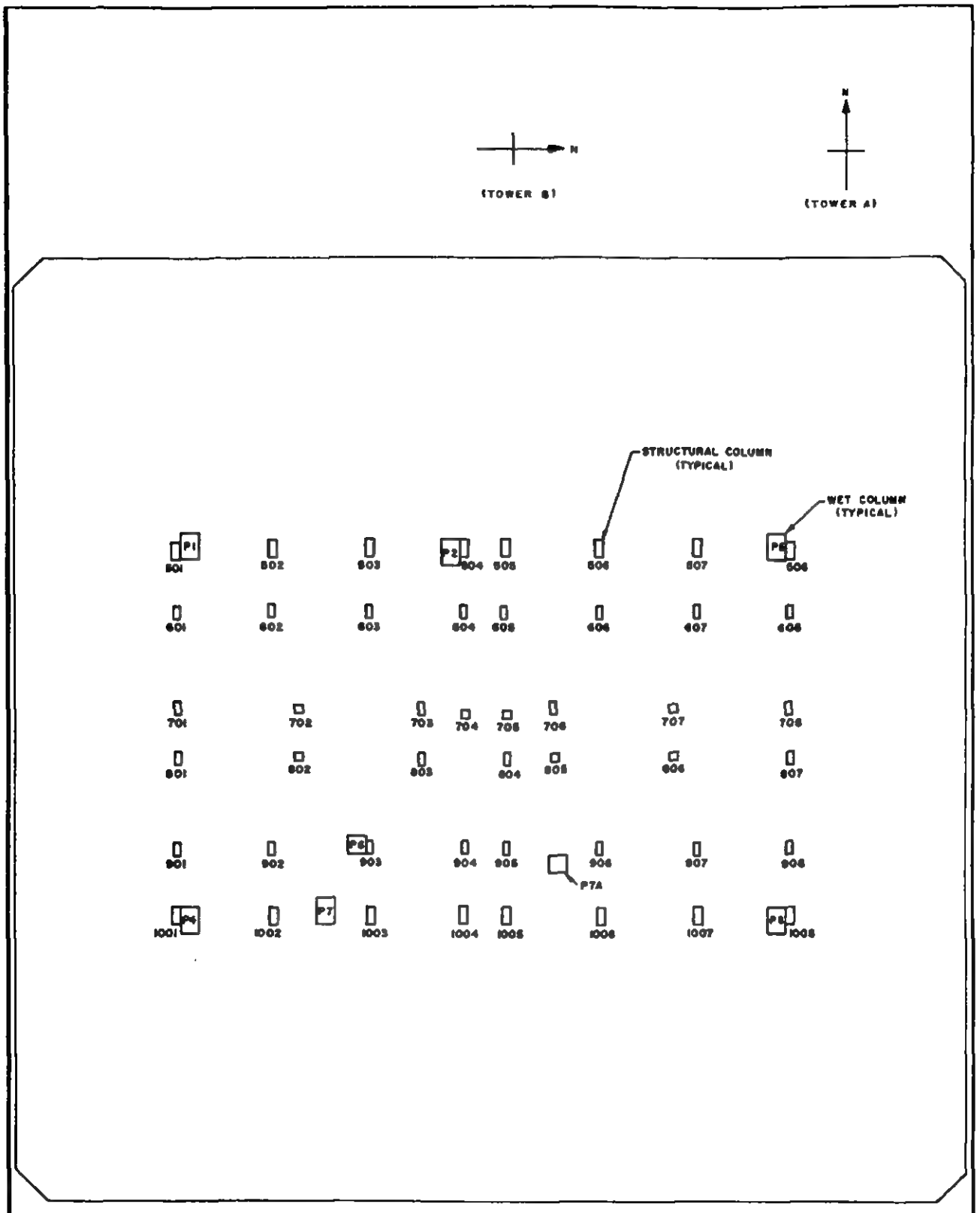


Figure 4-34 Wet Column Locations - Zone 5
Floor 76

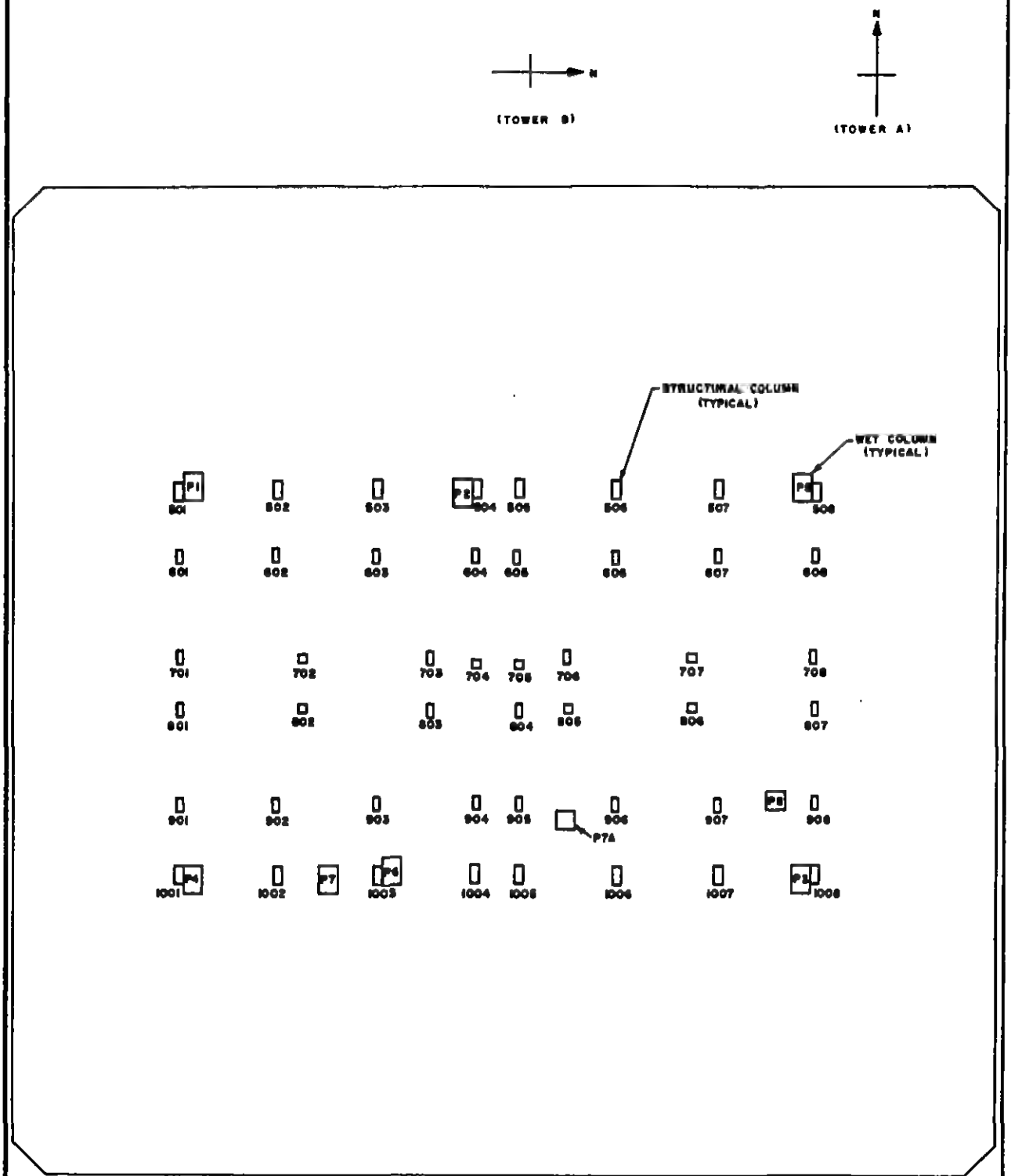


Figure 4-35 Wet Column Locations - Zone 5 Floor 77

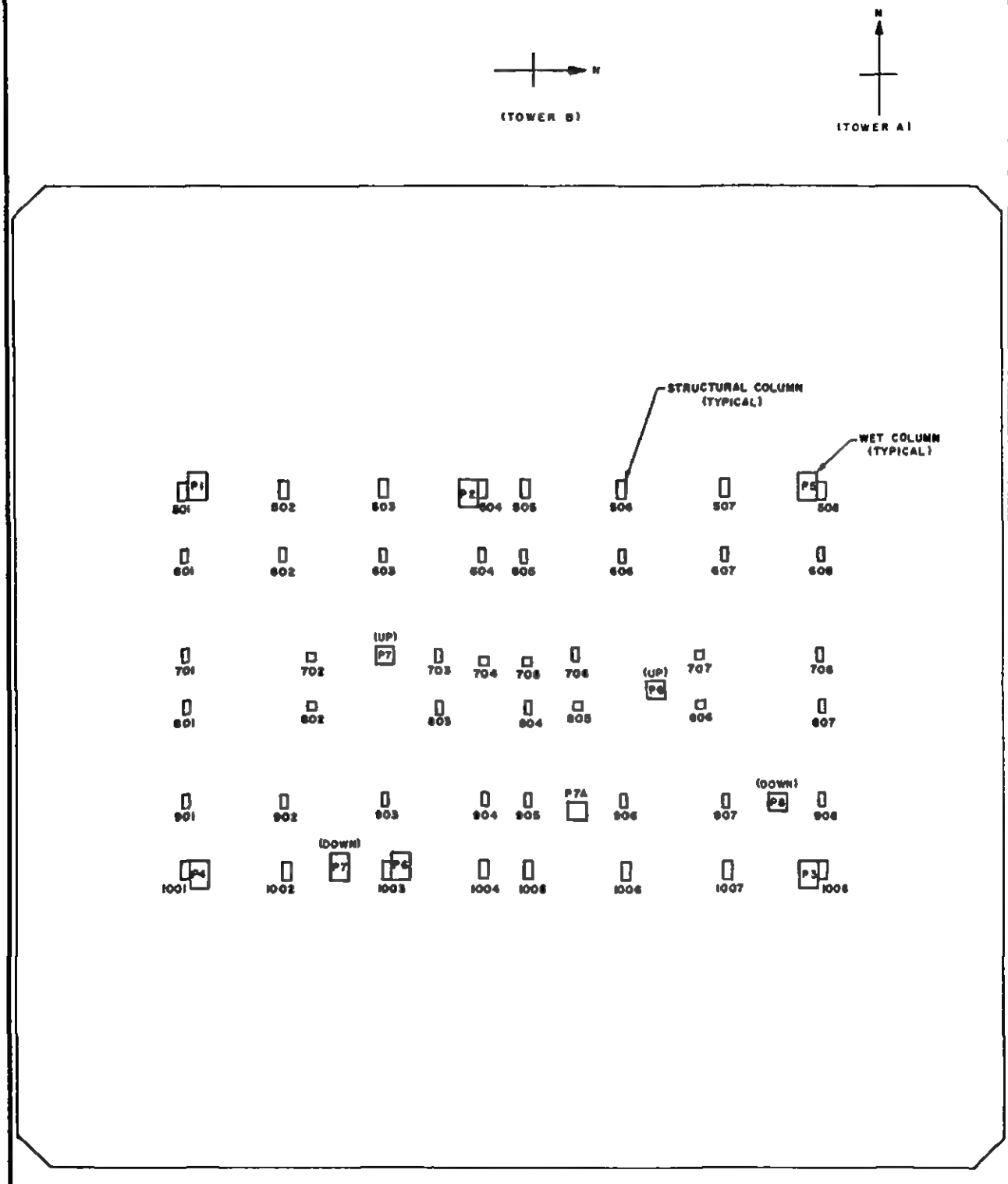


Figure 4-36 Wet Column Locations – Zone 5 Floor 78

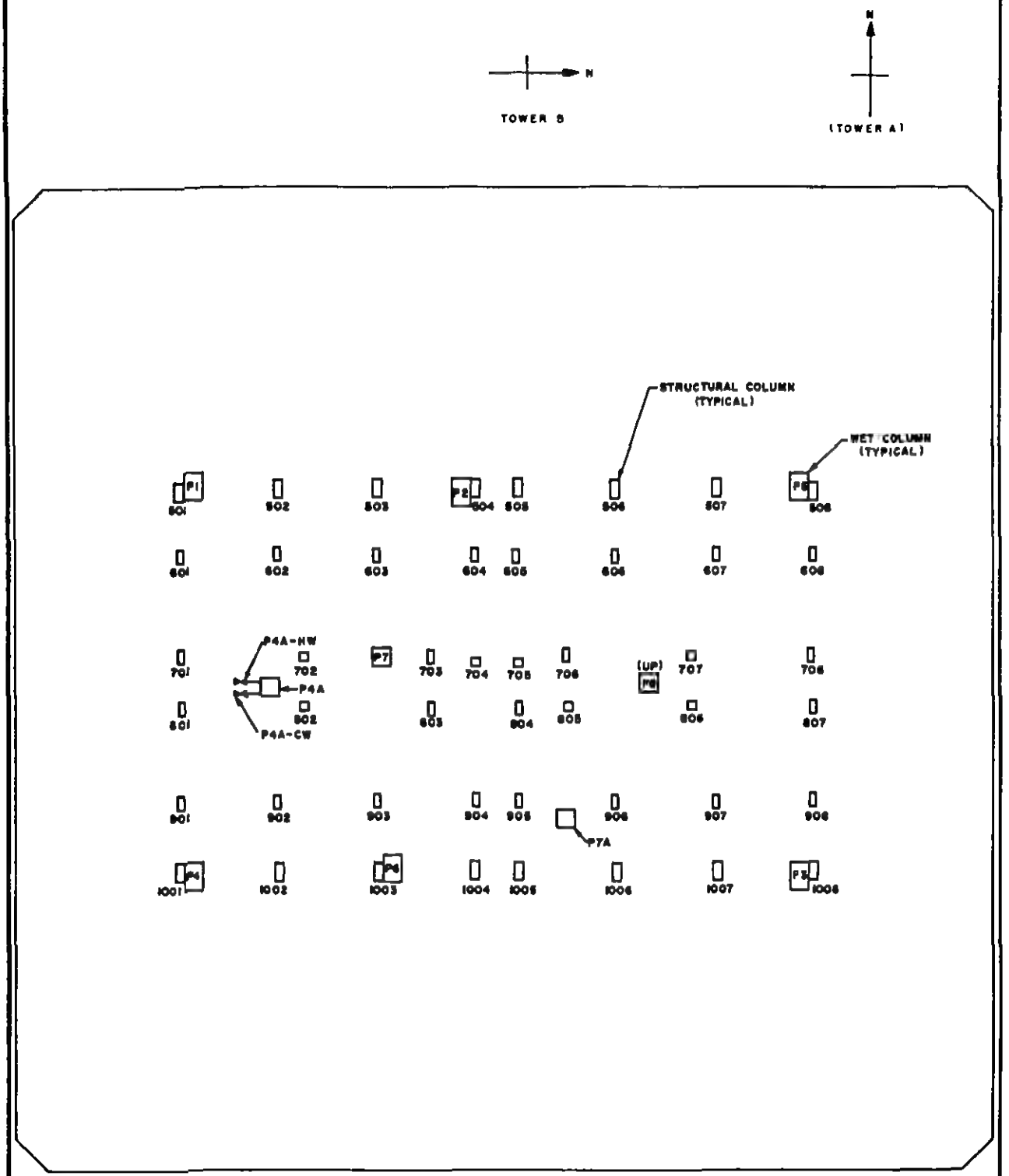


Figure 4-37 Wet Column Locations – Zone 5
Floor 79

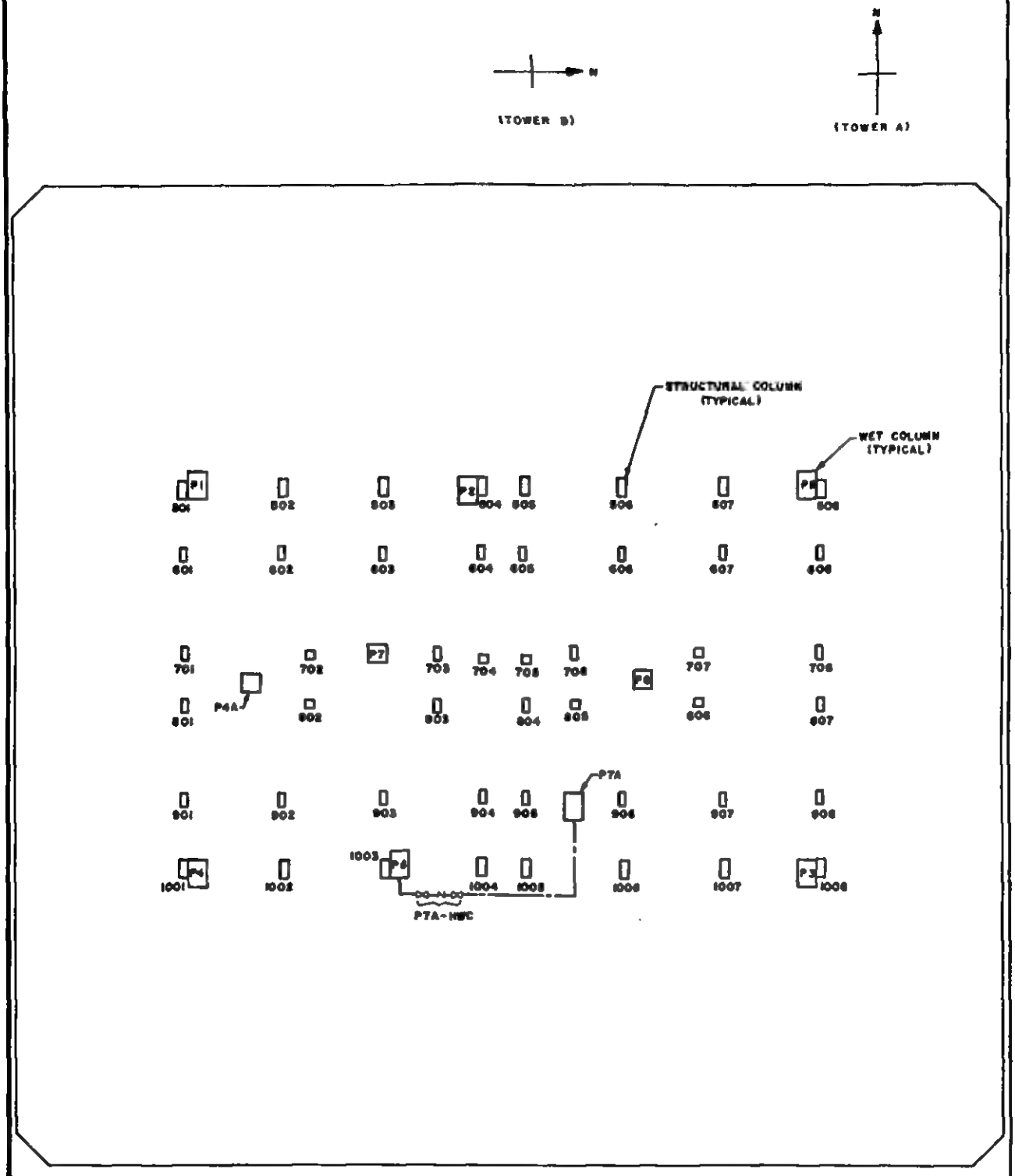


Figure 4-38 Wet Column Locations – Zone 5
Floors 80 and 81

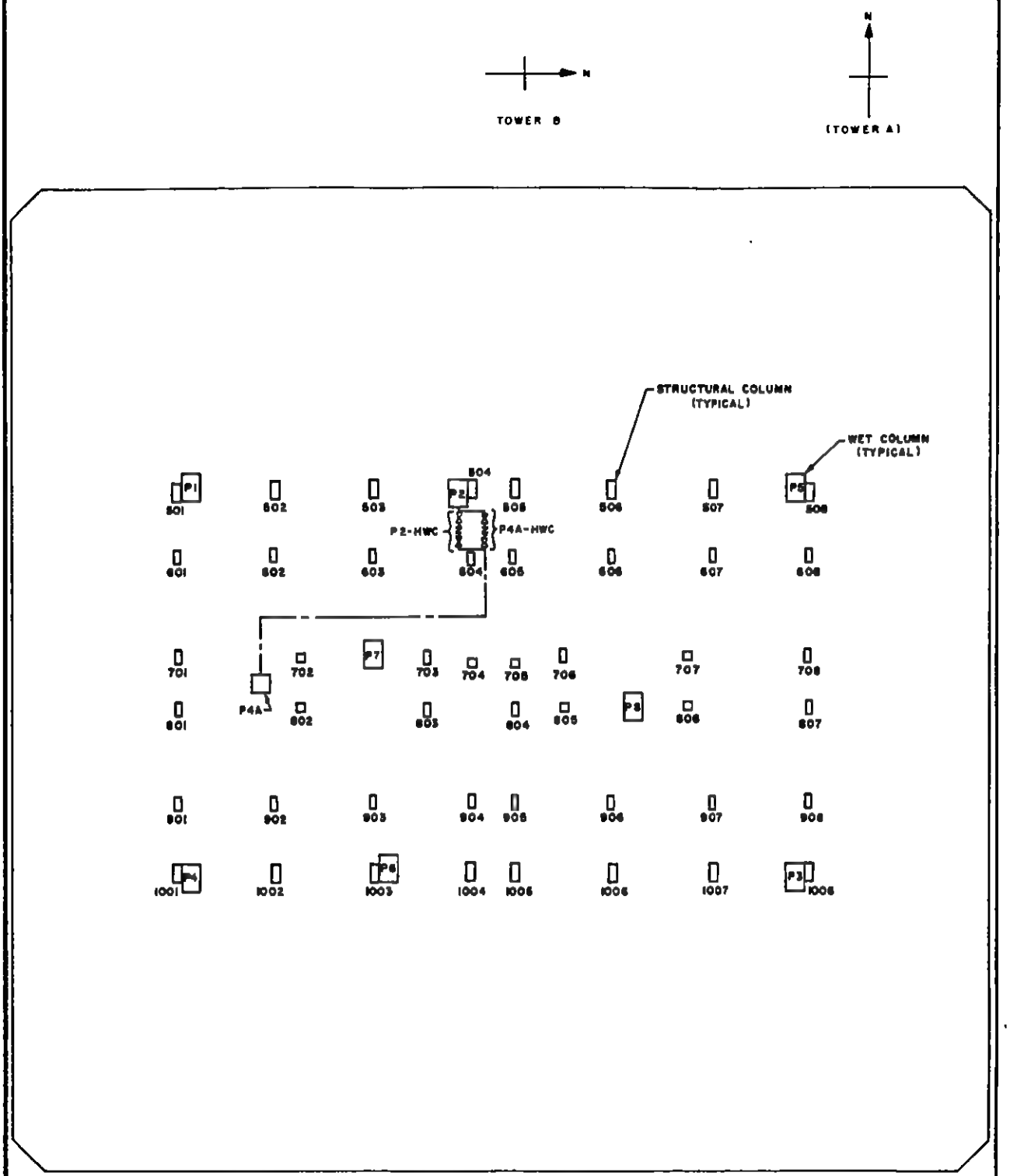


Figure 4-39 Wet Column Locations - Zone 5
Floor 82

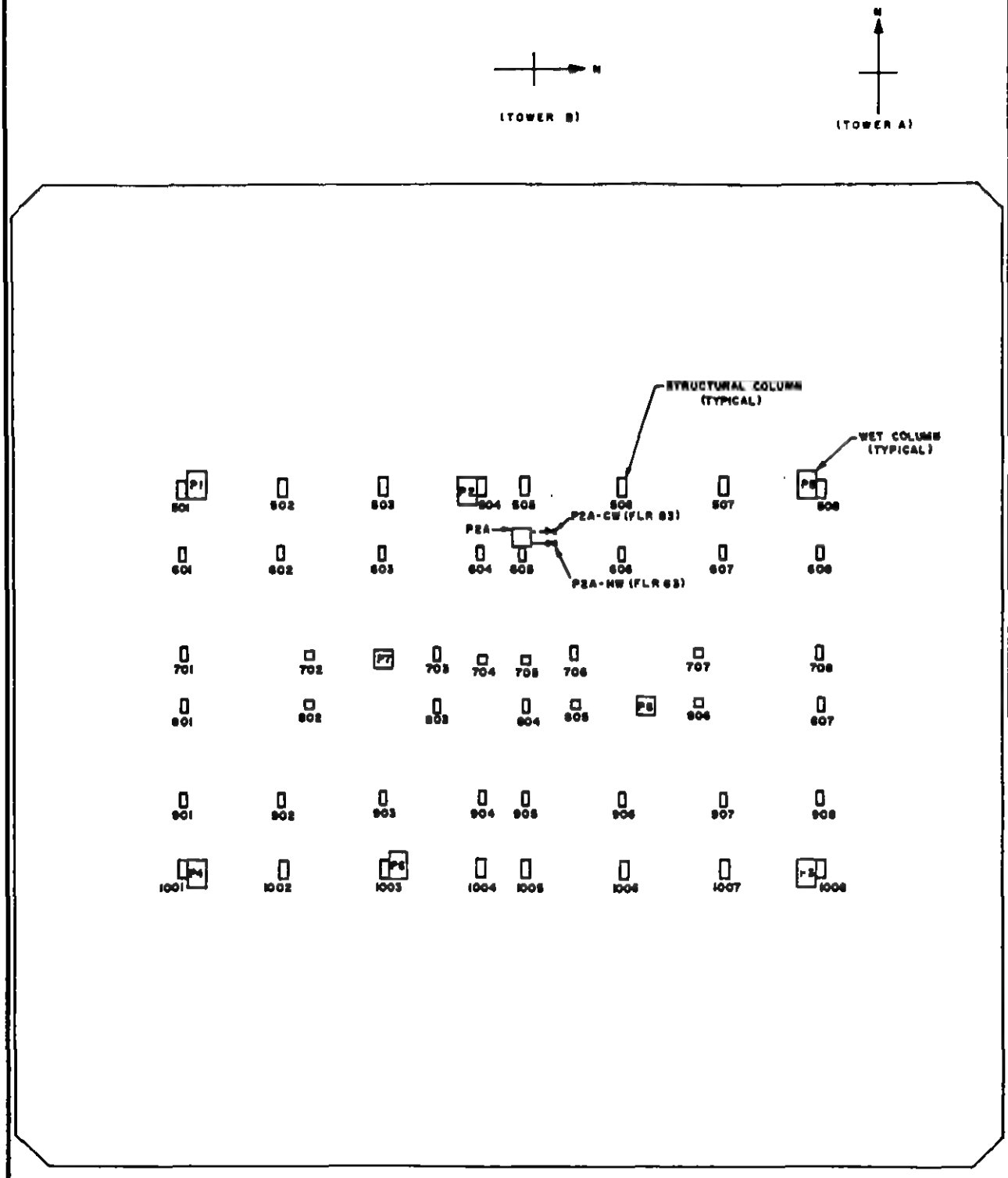


Figure 4-40 Wet Column Locations – Zone 5
Floor 83 Thru 86

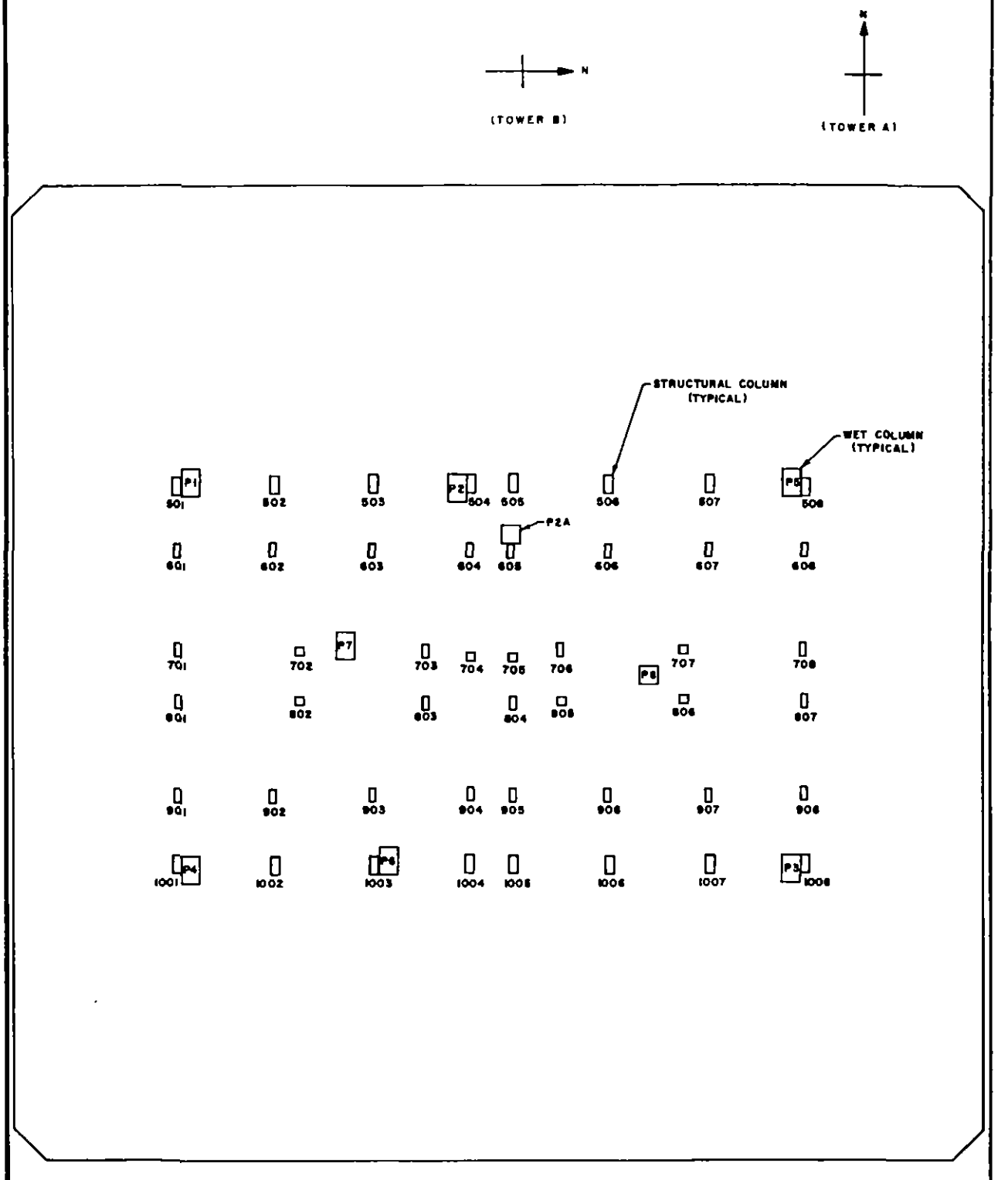


Figure 4-41 Wet Column Locations - Zone 5
Floors 87 Thru 92

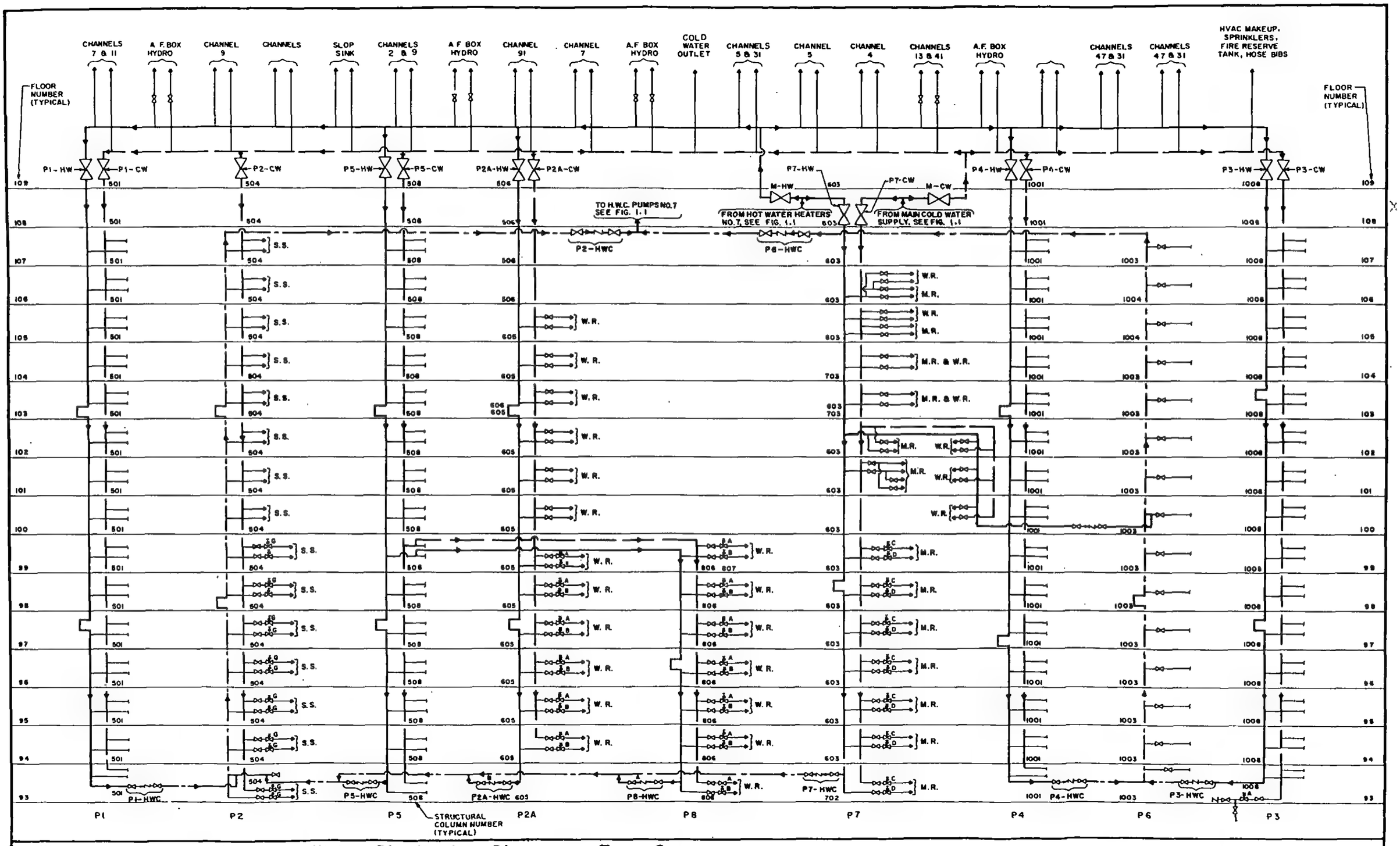
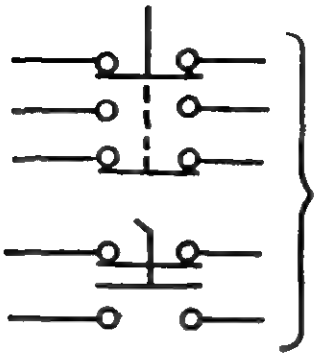


Figure 4-42 Domestic Water Distribution Diagram — Zone 6
Floors 93 Thru 107 — Towers A & B

The following references were used in the preparation of this manual:

Specifications and Drawings P-A-1 thru P-A-95, relating to Contract WTC 530.00, Plumbing - Towers A and B.

Switch, Normally Open
(Pushbutton Type)



Selector Switches

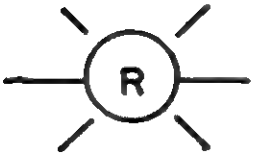
Winding

Transformer

Tachometer Generator

Silicon Controlled Rectifier

Thyrector



Indicating Lamp, Red

Indicating Lamp, White

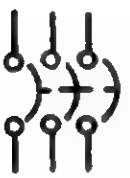
ELECTRICAL SYMBOLS APPENDIX E2

Conductors, Crossing, Connected

Conductors, Crossing, Not Connected

Conductors, Not Crossing, Connected

Fuse



Circuit Breaker, 3 Wire, Air Type

Resistor

Relay (Letters Inside Circle
Indicate Relay Designation)

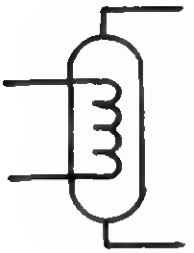
Contact, Normally Open

Contact, Normally Closed

Switch, Temperature Activated

Switch, Pressure Activated

Pump



Domestic Hot Water
Heater or Preheater

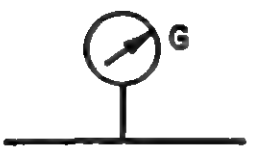
Air Vent

Cap or Plug

Thermostatic Trap

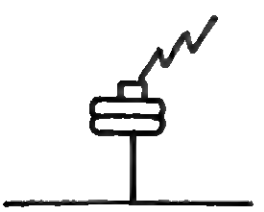
Strainer

Relief Valve



Pressure Gage

Thermometer



Pressure Switch

Domestic Cold Water

Domestic Hot Water

Domestic Hot Water,
Circulating

Expansion Loop,
Domestic Hot Water Line

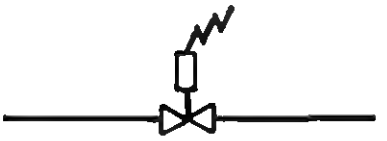
Low Pressure Steam

Hand Operated Valve

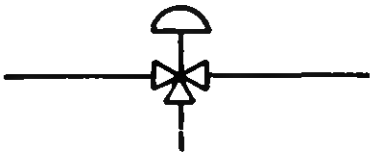
Check Valve

Pressure Reducing Valve

Diaphragm Operated Valve



Solenoid Operated Valve



Three-Way Mixing Valve,
Diaphragm Operated

Symbol	Description
B	Branch Control Air
CW	Cold Water
DCW	Domestic Cold Water
DHW	Domestic Hot Water
EPS	Excess Pressure Switch
^{o}F	Fahrenheit Degrees
HB	Hose Bibb
HPS	High Pressure Switch
HVAC	Heating, Ventilating, and Air Conditioning
HWC	Hot Water, Circulating
HZ	Hertz (Cycles Per Second)
LPS	Low Pressure Steam Low Pressure Switch
M	Main Control Air
P_1-CW (Typical)	Main Isolation Valve, Cold Water Riser, Wet Column P_1
P_7-HW (Typical)	Main Isolation Valve, Hot Water Riser, Wet Column P_7
P_{7A}-HWC (Typical)	Main Isolation Valve, Hot Water Circulating Riser, Wet Column P_{7A}
PET	Pressure-Electric Transducer
ø	Phase
PRVS	Pressure Reducing Valve Station
PST	Pumping Station
V	Volt(s)

A description of the components of the Master Controller, the Individual Pump Controller, and other aspects of Water Pump Control is presented in the following publication:

HANDBOOK

VARIABLE SPEED DRIVES

FOR

POTABLE WATER PRESSURE

CONTROL SYSTEM

480V-3Ø

WORLD TRADE CENTER

Job & Order Details: IKOR Job No. 1125
Fairbanks Morse
Order No. 051356A-5D

Published by: IKOR Incorporated
Environmental Control Systems
Northwest Industrial Park
Burlington, Mass. 01803

Note: Copies of the above Handbook may be obtained from the Operations Division of the World Trade Department.

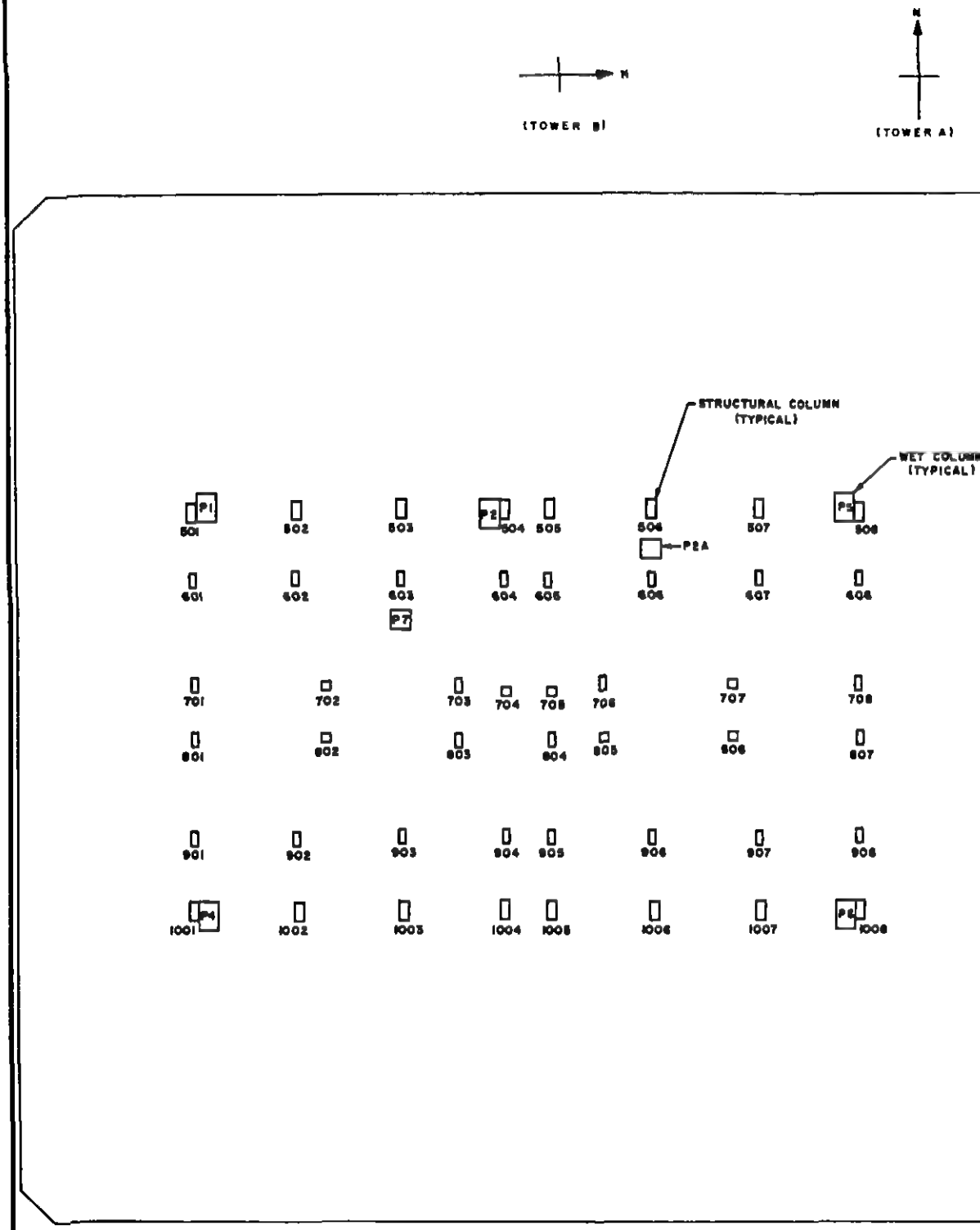


Figure 4-51 Wet Column Locations – Zone 6
Floors 108 and 109

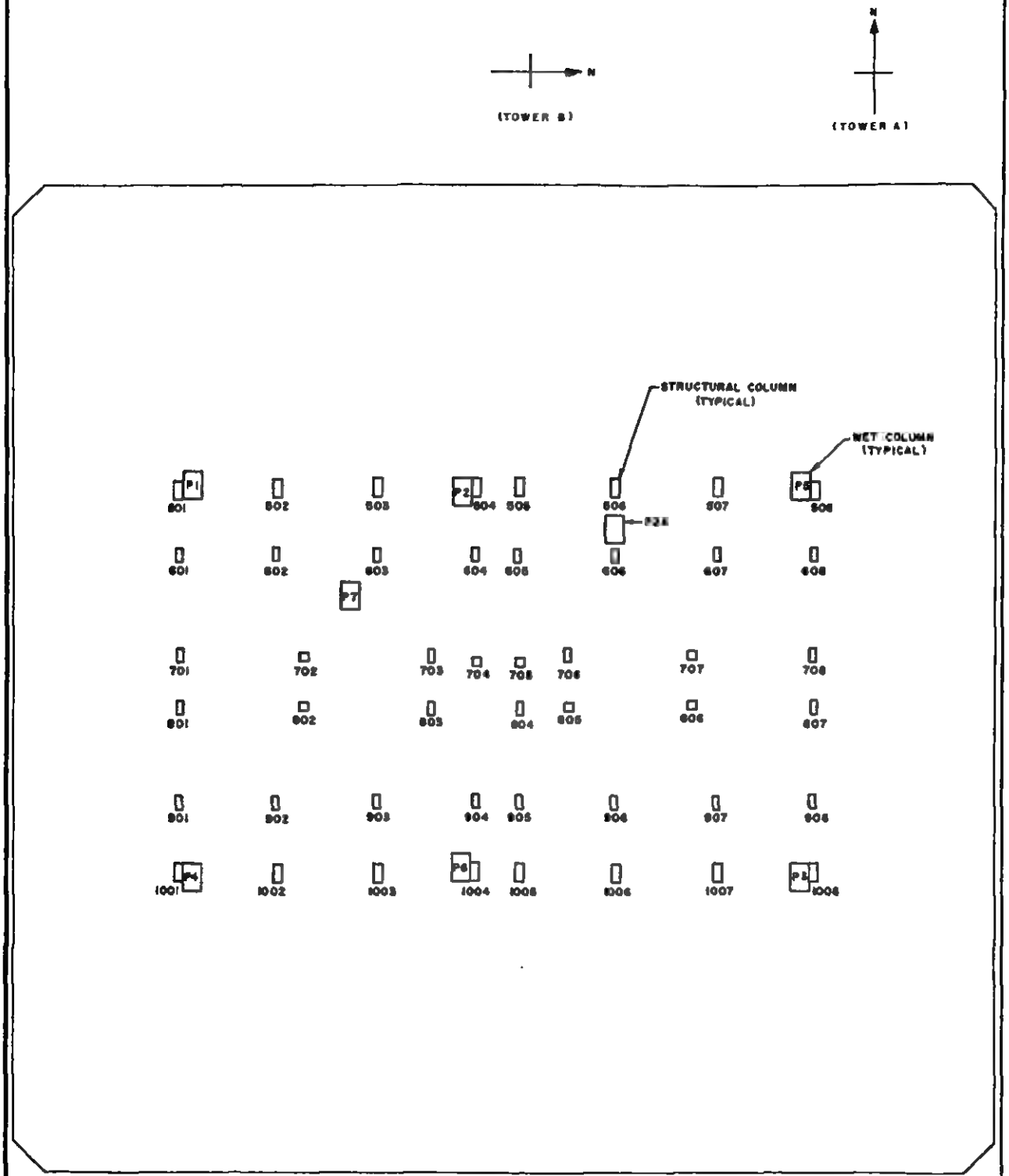


Figure 4-50 Wet Column Locations – Zone 6
Floors 106 and 107

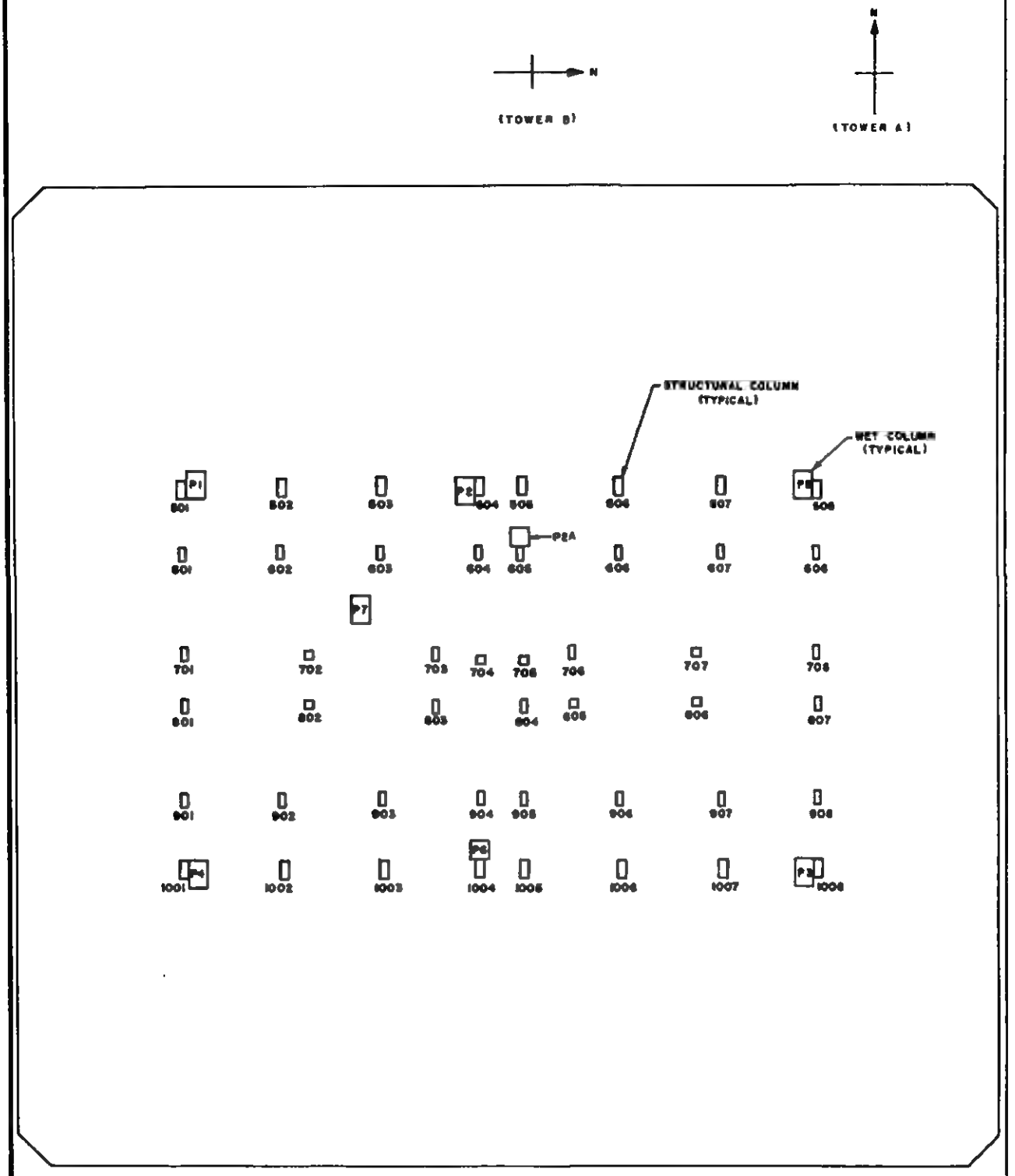


Figure 4-49 Wet Column Locations – Zone 6
Floor 105

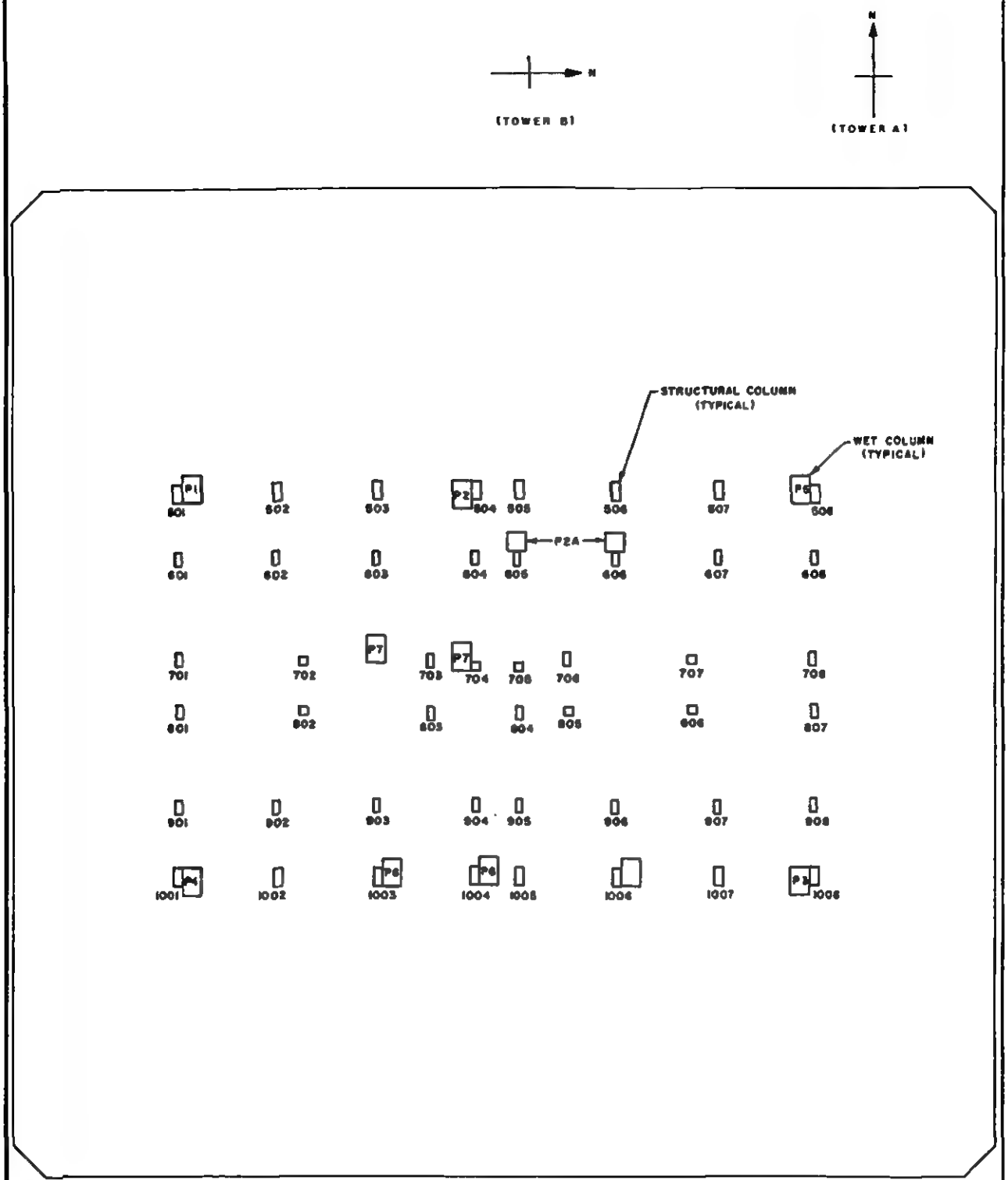


Figure 4-48 Wet Column Locations – Zone 6
Floors 103 and 104

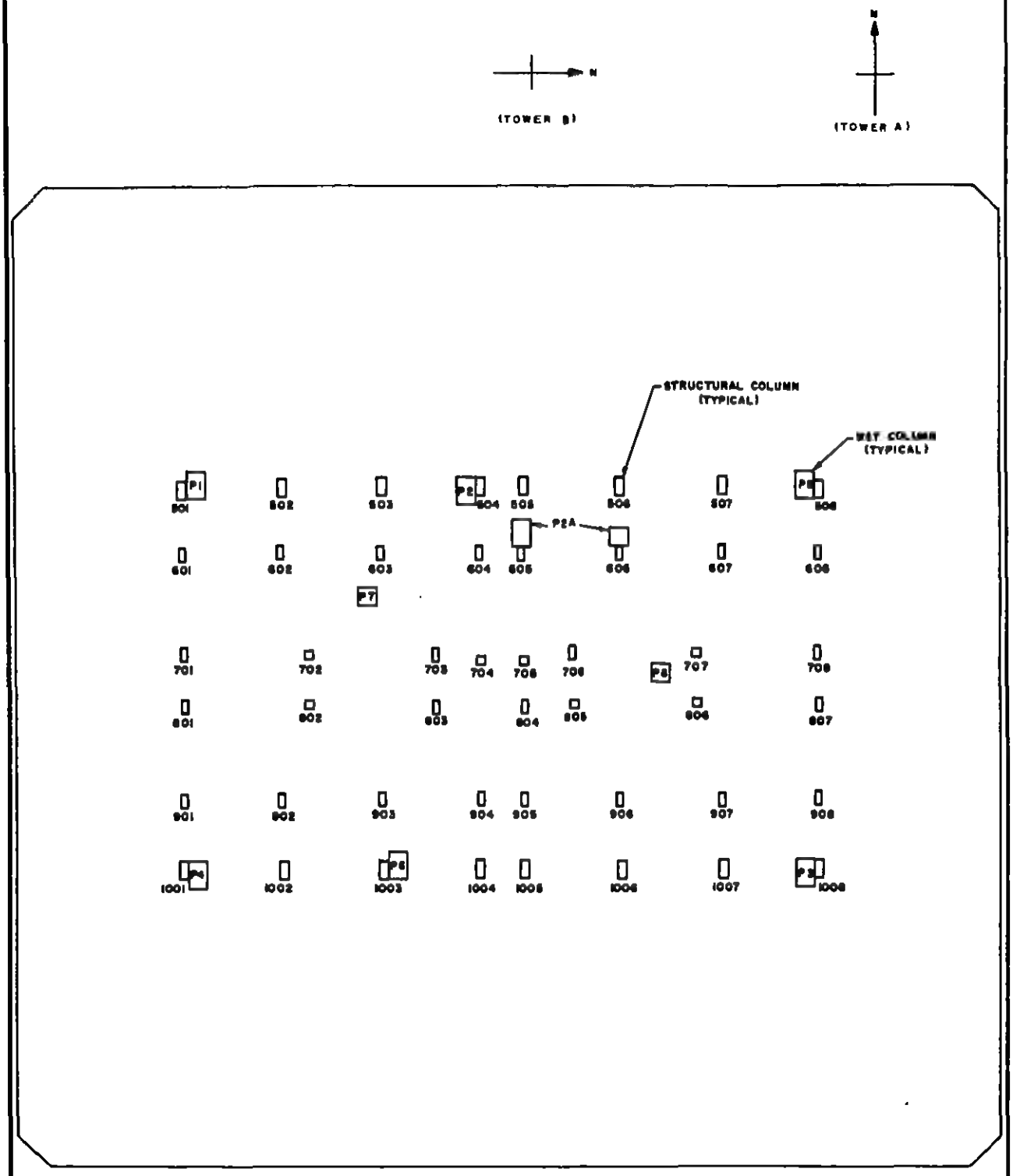


Figure 4-47 Wet Column Locations – Zone 6
Floors 94 Thru 103

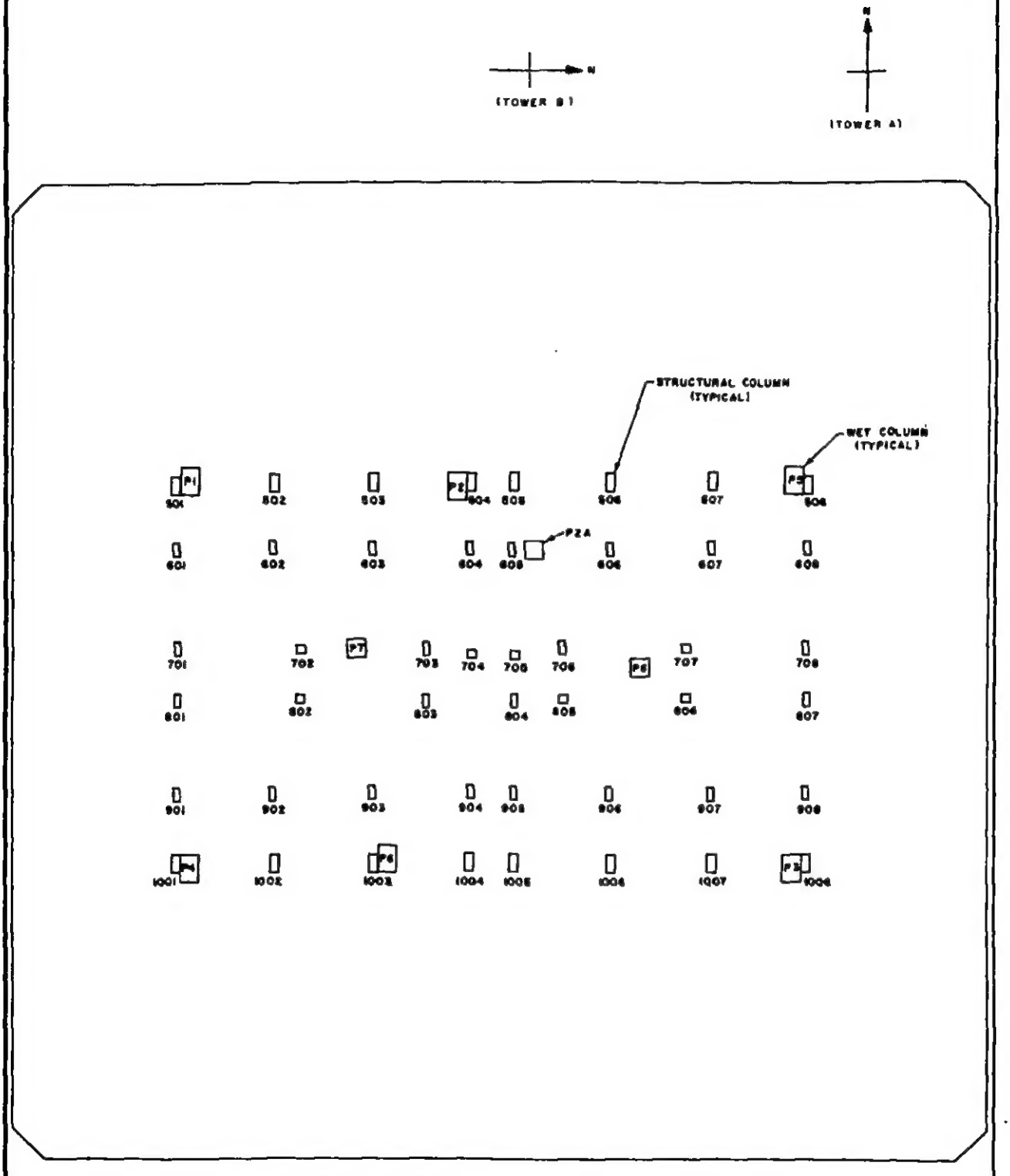


Figure 4-46 Wet Column Locations – Zone 6
Floor 93

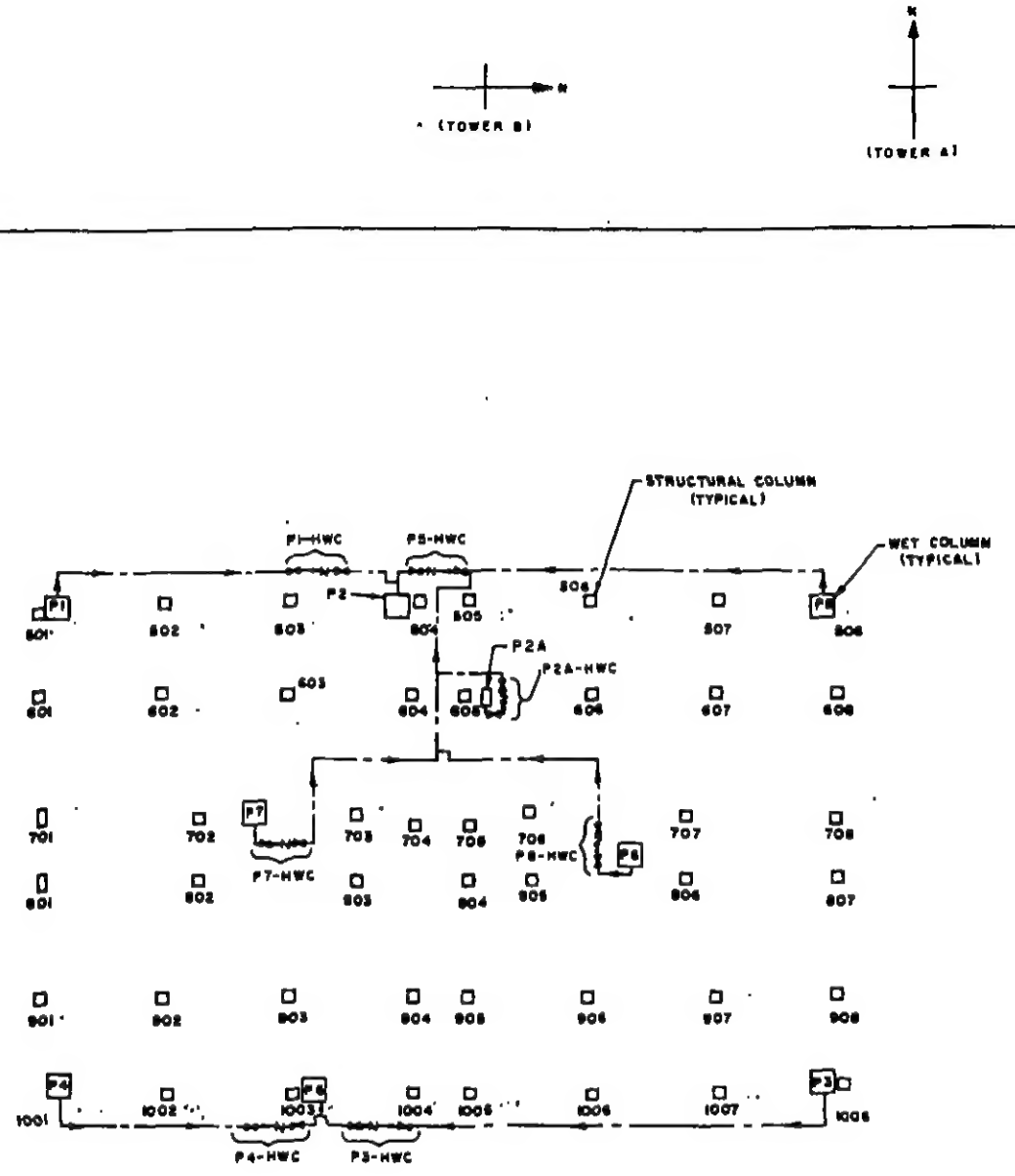


Figure 4-45 Hot Water Circulation System Valves – Zone 6 Floor 93

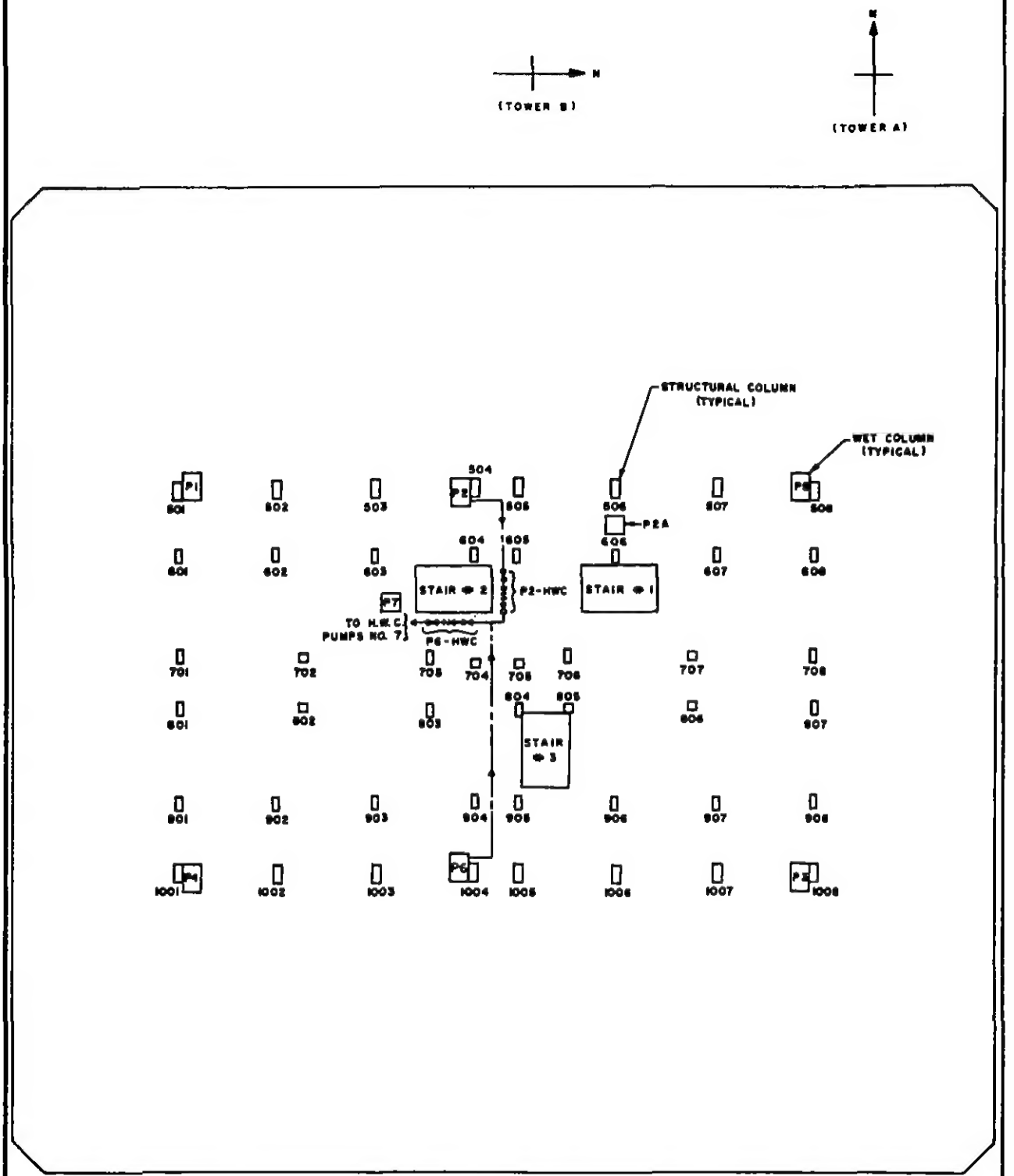


Figure 4-44 Hot Water Circulation System Valves – Zone 6 Floor 107

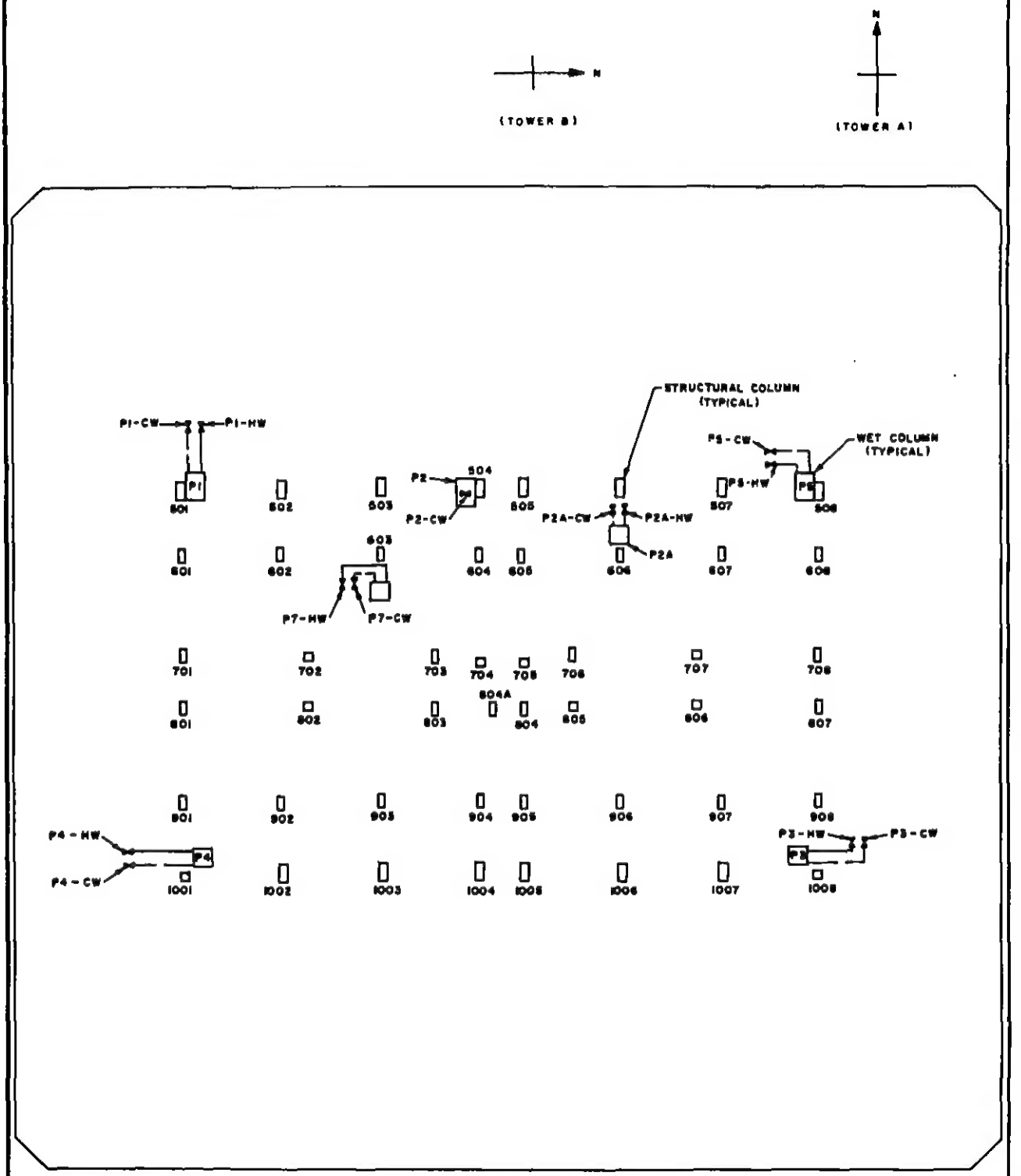


Figure 4-43 Main Isolation Valve Locations - Zone 6
Mechanical Equipment Room—Floors 108 & 109